

Daily report

26-04-2020

## Analysis and prediction of COVID-19 for EU-EFTA-UK and other countries

## Foreword

The present report aims to provide a comprehensive picture of the **pandemic situation of COVID-19** in the EU countries, and to be able to foresee the situation in the next coming days.

We employ an **empirical model**, verified with the evolution of the number of confirmed cases in previous countries where the epidemic is close to conclude, including all provinces of China. The model does not pretend to interpret the causes of the evolution of the cases but to permit the **evaluation of the quality of control measures made in each state** and a **short-term prediction of trends**. Note, however, that the effects of the measures' control that start on a given day are not observed until approximately 7-10 days later.

The model and predictions are based on two parameters that are daily fitted to available data:

- ✓  $\alpha$ : the velocity at which spreading specific rate slows down; the higher the value, the better the control.
- ✓  $K$ : the final number of expected cumulated cases, which cannot be evaluated at the initial stages because growth is still exponential.

We show an individual report with 8 graphs and a table with the **short-term predictions** for different countries and regions. We are adjusting the model to **countries and regions** with at least 4 days with more than 100 confirmed cases and a current load over 200 cases. The **predicted period** of a country depends on the number of datapoints over this 100 cases threshold, and is of 5 days for those that have reported more than 100 cumulated cases for 10 consecutive days or more. For short-term predictions, we assign higher weight to last 3 points in the fittings, so that changes are rapidly captured by the model. The whole methodology employed in the inform is explained in the last pages of this document.

In addition to the individual reports, the reader will find an initial dashboard with a brief analysis of the situation in EU-EFTA-UK countries, some summary figures and tables as well as **long-term predictions** for some of them, when possible. These long-term predictions are evaluated without different weights to datapoints. We also discuss a specific issue every day.

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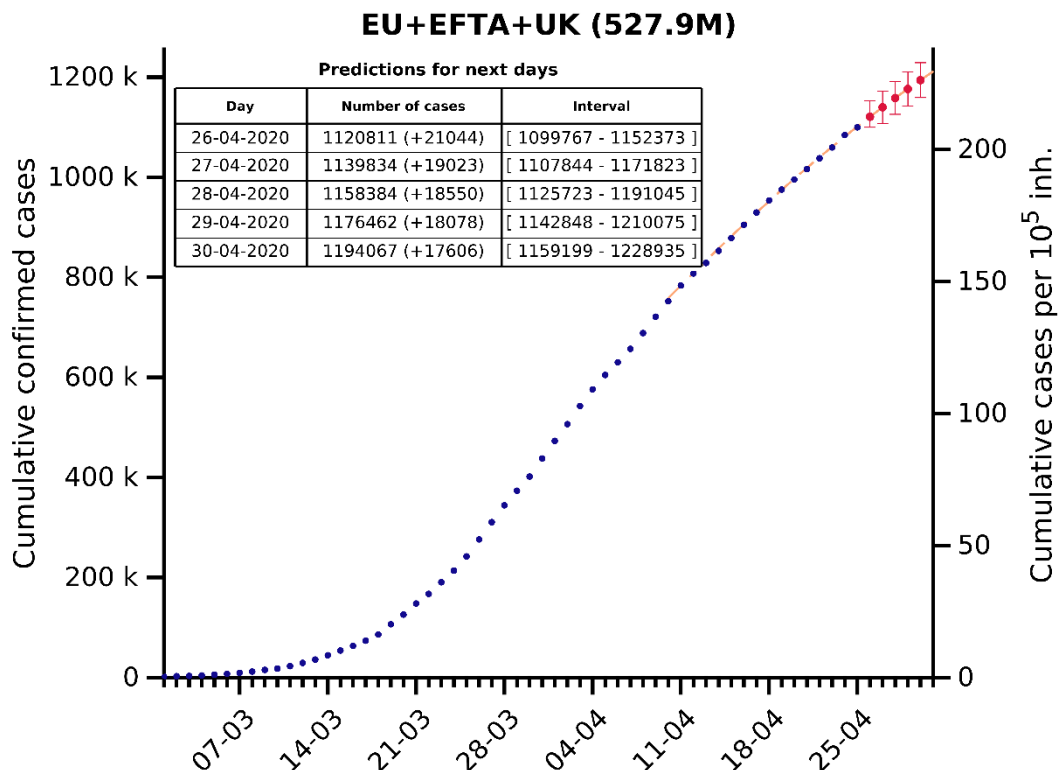


## **(0) Executive summary – Dashboard**

## Weekend short version

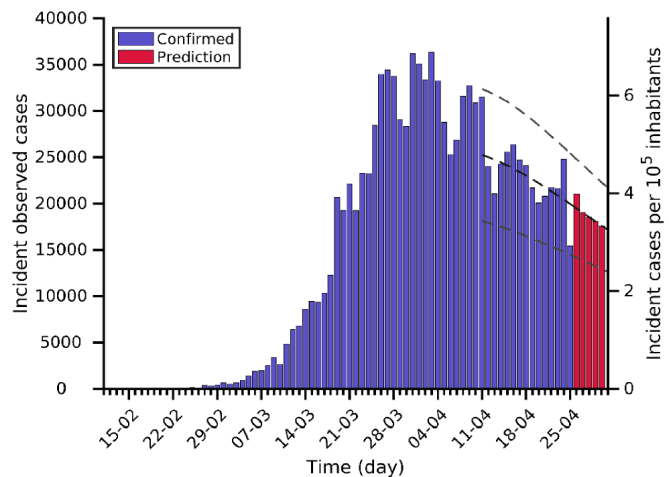
### Attack rate and short-term predictions in EU+EFTA+UK

Short-term predictions, based on last 15 points with increased weight on last 3:



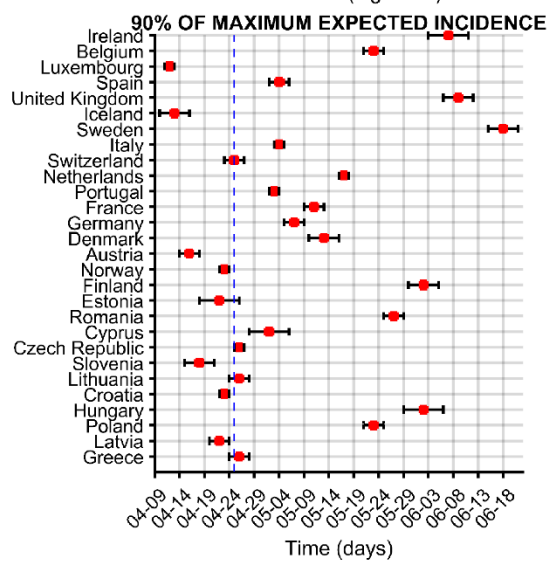
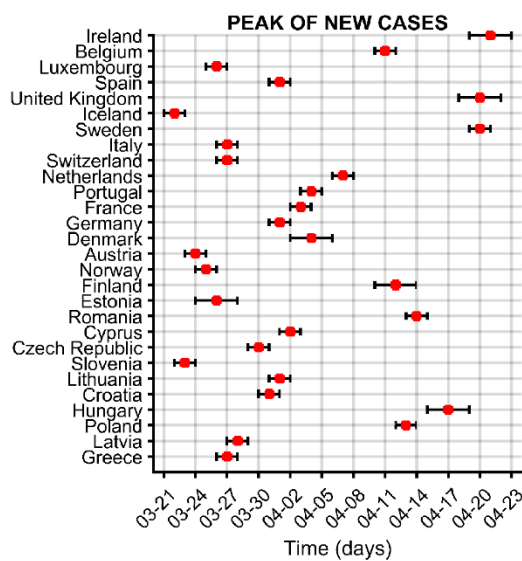
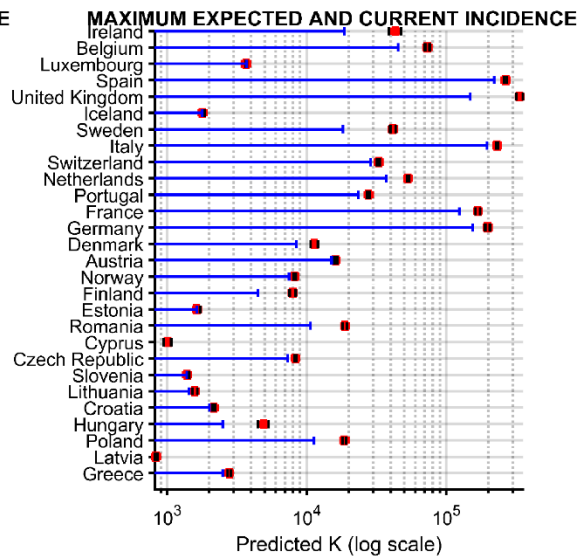
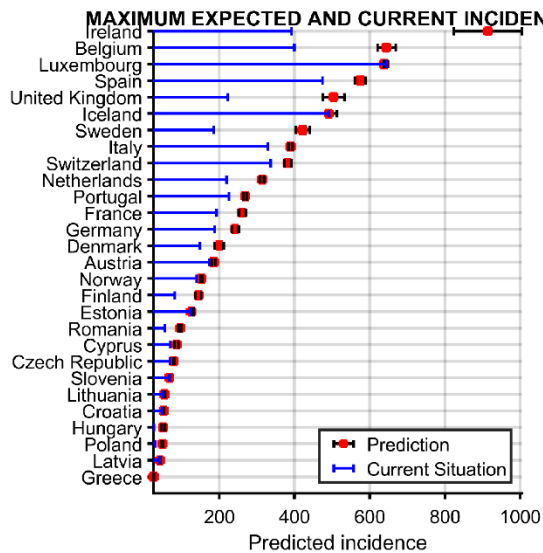
### Highlights and/or warnings

- Today, Spain has not reported new cases, maybe as part of the plan for updating data. Therefore, this is reflected in total new cases in EU+EFTA+UK (15,417), which compensates yesterday's sudden increase (24,780).
- United Kingdom remains at the level of 5,000 daily new cases.

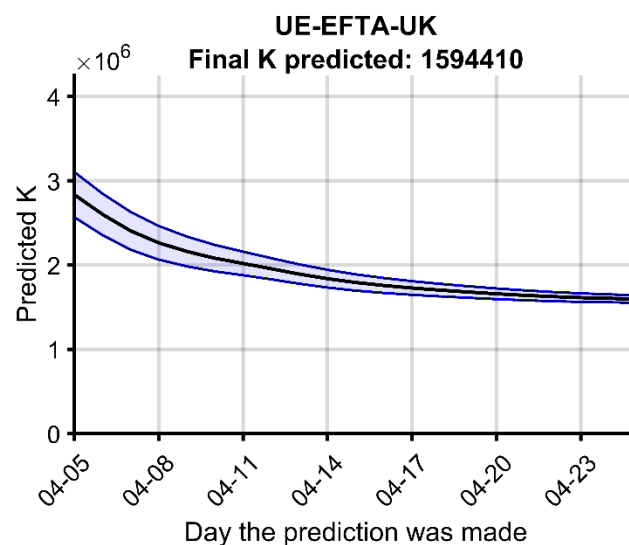


### Long-term predictions

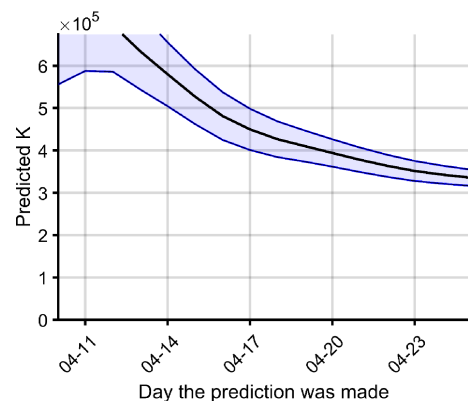
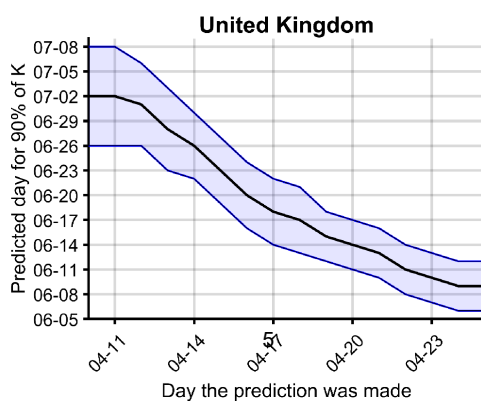
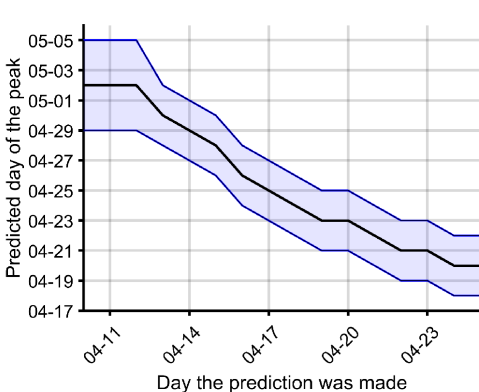
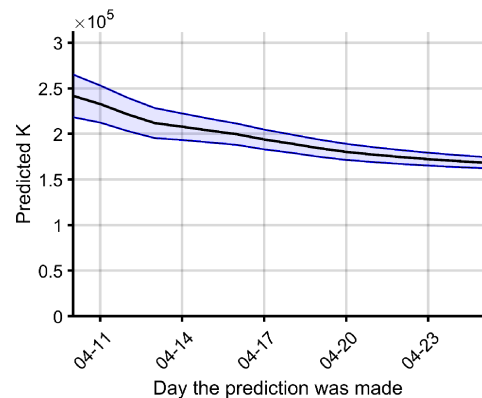
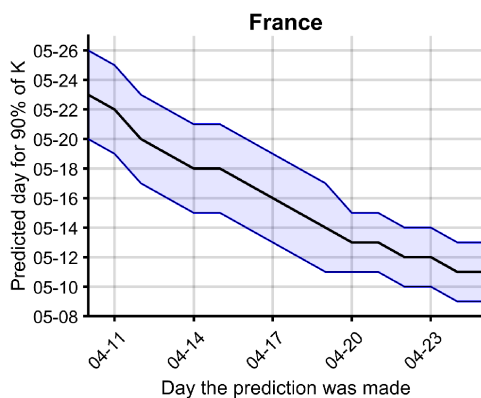
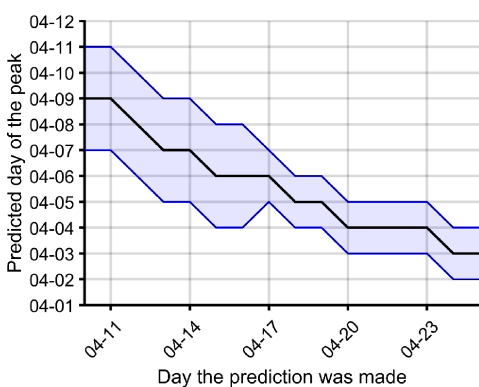
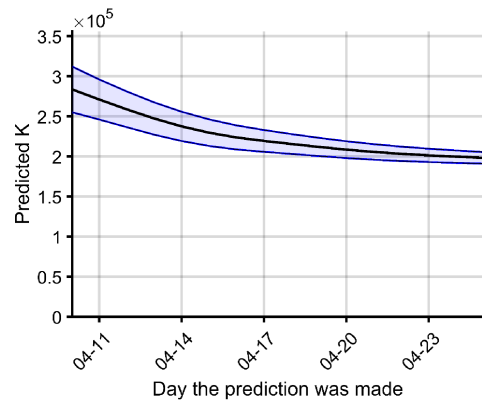
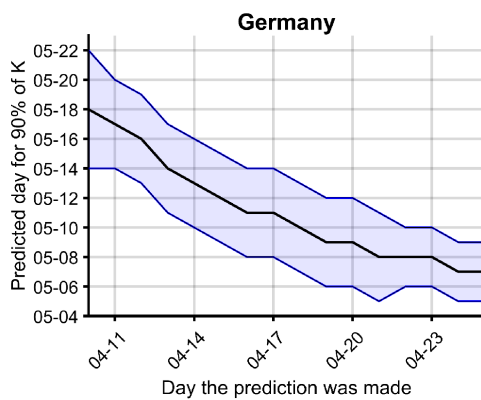
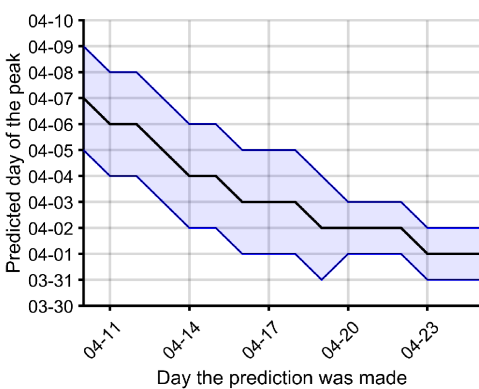
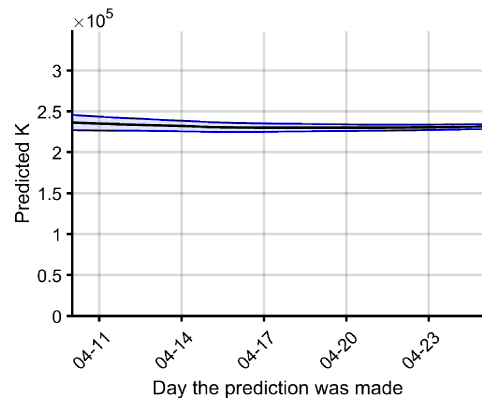
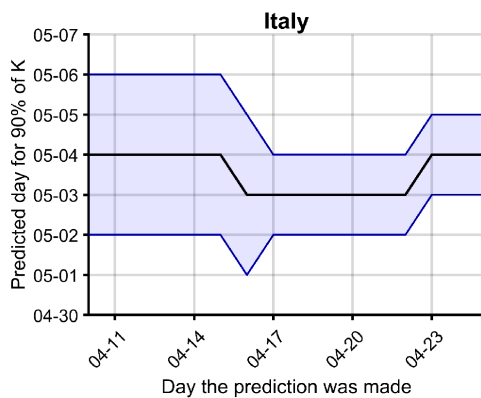
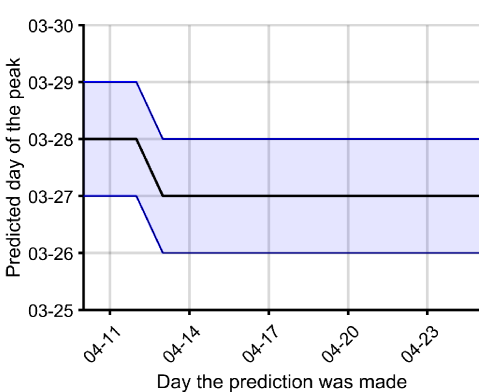
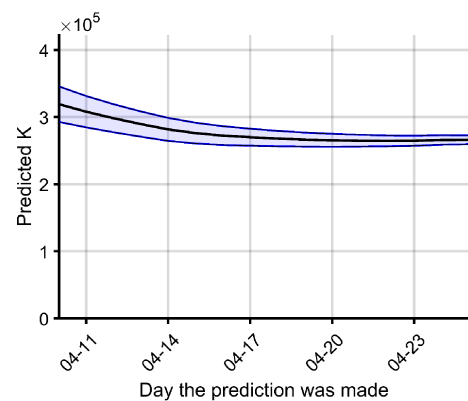
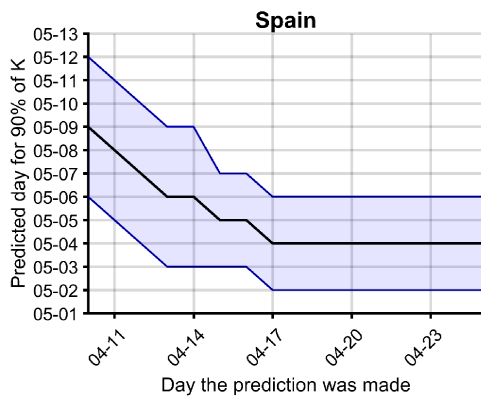
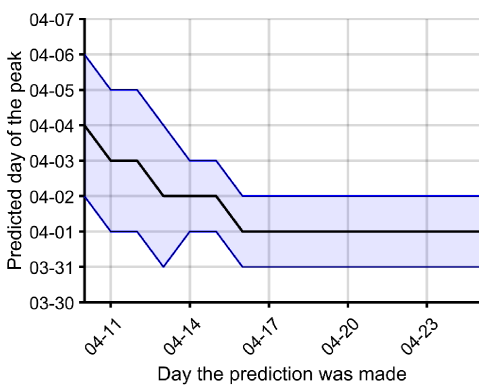
**Long-term predictions**, evaluated with the **whole historical series**. See figure in the next page. Up-left: Predictions of maximum incidences per country (total final expected attack rate per  $10^5$  inh.). Up-right: Predictions of maximum absolute number of cases per country (K, in log scale). Blue lines indicate current situation. Bottom-left: Time in which peak in new cases was achieved / will be achieved. Bottom-right: Time at which 90 % of K was achieved / will be achieved. Blue dotted line indicates current date.



**Final expected K for UE+EFTA+UK.** Evolution of predicted K with time, where convergence to best estimate is seen. Last prediction is numerically shown.



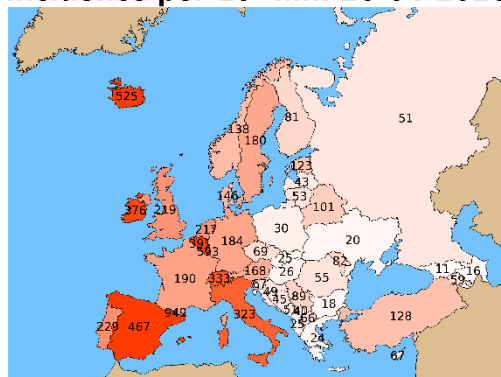
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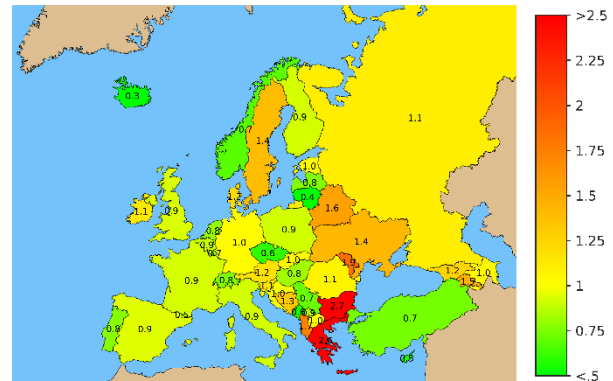
## Situation and trends per country

### Maps of current incidence and $\rho$

Incidence per 10<sup>5</sup> inh. 26-04-2020



$\rho$  25-04-2020



**Table of current situation in EU countries.** Colour scale is relative except when indicated, this means that it is applied independently to each column, and distinguishes best (green) from worst (red) situations according to each of the variables. **New!** Last column ( $EPG_{EST}$ ) indicates EPG assessed with **estimated real 14-day attack rate** (see report 39 for details).  $EPG_{REP}$  is calculated with **data reported by countries**.  $EPG_{REP}$  and  $EPG_{EST}$  **cannot be compared between them** because scales are different, but can be independently used for estimating risk of countries according to reported or estimated real situation, respectively.

Country	Reported data						Indexes		
	Cumulative cases	Attack rate /10 <sup>5</sup> inh.	Cumulative deaths	Mortality /10 <sup>5</sup> inh.	Active cases (last 14 days)	14-day attack rate /10 <sup>5</sup> inh.	$\rho_3^{(1)}$	$EPG_{REP}^{(2)}$	$EPG_{EST}^{(3)}$
Spain	219,764	474.2	22,524	48.6	57,912	125.0	1.01	126	1,380
Italy	195,351	328.7	26,384	44.4	43,080	72.5	0.88	63	898
Germany	154,175	188.2	5,640	6.9	33,696	41.1	0.87	36	159
United Kingdom	148,377	223.3	20,319	30.6	69,386	104.4	0.87	91	1,428
France	124,114	191.8	22,614	34.9	30,324	46.9	1.14	53	1,109
Belgium	45,325	399.1	6,917	60.9	17,307	152.4	0.86	131	2,557
Netherlands	37,190	218.9	4,409	26.0	12,777	75.2	0.72	54	716
Switzerland	28,811	336.2	1,328	15.5	3,991	46.6	0.65	30	154
Portugal	23,392	225.5	880	8.5	7,405	71.4	0.91	65	283
Ireland	18,561	392.7	1,063	22.5	9,633	203.8	1.03	210	1,532
Sweden	18,177	184.8	2,192	22.3	8,026	81.6	1.22	99	2,027
Austria	15,134	173.7	536	6.2	1,327	15.2	0.92	14	53
Poland	11,273	29.5	524	1.4	4,917	12.9	0.82	11	67
Romania	10,635	53.8	575	2.9	4,645	23.5	1.05	25	159
Denmark	8,445	147.8	418	7.3	2,449	42.9	1.07	46	252
Norway	7,467	139.1	193	3.6	1,147	21.4	0.77	16	46
Czech Republic	7,352	69.3	218	2.1	1,450	13.7	0.68	9	32
Finland	4,475	81.3	186	3.4	1,570	28.5	0.92	26	146
Luxembourg	3,711	644.3	85	14.8	441	76.6	0.70	54	ND
Greece	2,506	22.4	130	1.2	425	3.8	6.76	26	164
Hungary	2,500	25.6	272	2.8	1,090	11.2	1.05	12	187
Croatia	2,016	47.9	54	1.3	482	11.4	1.12	13	ND
Iceland	1,790	491.4	10	2.7	101	27.7	0.36	10	ND
Estonia	1,635	124.6	46	3.5	331	25.2	0.69	18	ND
Lithuania	1,438	49.4	41	1.4	385	13.2	0.29	4	ND
Slovenia	1,388	66.8	81	3.9	200	9.6	0.70	7	ND
Slovakia	1,373	25.2	17	0.3	645	11.8	0.86	10	ND
Bulgaria	1,247	17.5	55	0.8	586	8.2	1.94	16	ND
Cyprus	810	69.2	17	1.5	194	16.6	0.56	9	ND
Latvia	804	40.8	12	0.6	174	8.8	0.76	7	ND
Malta	448	104.4	4	0.9	78	18.2	ND	ND	ND
Liechtenstein	83	215.3	1	2.6	3	7.8	ND	ND	ND

Scale									
Worst	Worst	Worst	Worst	Worst	Worst	Worst	2.0	500	2500
Best	Best	Best	Best	Best	Best	Best	0.0	0	0.0

<sup>(1)</sup> Disclaimer: parameter  $\rho$  is very sensitive and experiments daily variations.  $\rho_3$  is the average of 3 consecutive  $\rho$ , but can still fluctuate. <sup>(2)</sup> EPG stands for Effective Growth Potential.  $EPG_{REP}$  is obtained by multiplying attack rate of last 14 days per 10<sup>5</sup> inhabitants (i.e. density of cases) by  $\rho_3$  (a value related with effective reproduction number and that, therefore, determines the dynamics for subsequent days).  $EPG_{EST}$  is obtained by multiplying estimated real attack rate of last 14 days per 10<sup>5</sup> inhabitants by  $\rho_3$ .

## Time indicators by country

This table summarizes a few time indicators for each country: time since 50 cases were reported, time interval between an attack rate of  $1/10^5$  inhabitants and an attack rate of  $10/10^5$  inhabitants, and time interval between attack rates of 10 to 100 per  $10^5$  inhabitants (only for countries that have overtaken this threshold).

Countries	Days since the first 50 cases	Time interval between 1 and 10 cases / $10^5$ inh. (days)	Time interval between 10 and 100 cases / $10^5$ inh. (days)
Italy	64	11	16
France	58	10	20
Germany	58	12	17
Spain	57	7	12
United Kingdom	54	11	19
Norway	53	9	24
Switzerland	53	9	12
Netherlands	52	11	20
Sweden	52	10	28
Austria	51	10	14
Belgium	51	11	14
Greece	50	18	ND
Iceland	50	5	15
Denmark	48	4	30
Czech Republic	47	11	ND
Finland	46	12	ND
Portugal	46	9	15
Slovenia	46	6	ND
Ireland	45	8	18
Romania	45	15	ND
Estonia	44	5	30
Poland	44	13	ND
Bulgaria	42	16	ND
Luxembourg	42	6	7
Slovakia	42	18	ND
Croatia	41	12	ND
Latvia	40	12	ND
Cyprus	39	12	ND
Hungary	39	13	ND
Malta	38	8	34
Lithuania	37	9	ND
Liechtenstein	32	9	11

## Situation, trends and long-term predictions in Italian and Spanish regions

### Italy

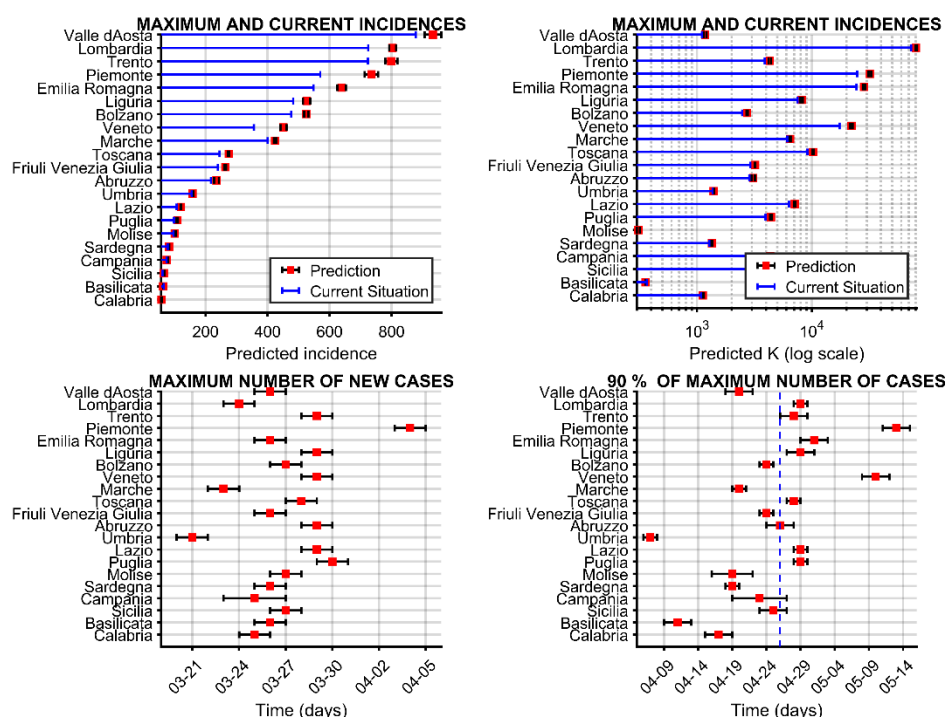
Country	Reported data						Indexes		
	Cumulative cases	Attack rate / 10 <sup>5</sup> inh.	Cumulative deaths	Mortality / 10 <sup>5</sup> inh.	Active cases (last 14 days)	14-day attack rate / 10 <sup>5</sup> inh	$\rho_3^{(1)}$	EPG <sub>REP</sub> <sup>(2)</sup>	EPG <sub>EST</sub> <sup>(3)</sup>
Lombardia	72,889	725.9	13,325	132.7	13,837	137.8	1.05	144	2,842
Piemonte	24,820	569.7	2,823	64.8	8,160	187.3	1.06	198	2,571
Emilia Romagna	24,450	548.3	3,386	75.9	4,352	97.6	0.79	77	1,127
Veneto	17,471	356.1	1,315	26.8	3,394	69.2	0.86	59	505
Toscana	9,147	245.3	778	20.9	1,912	51.3	0.81	42	402
Liguria	7,488	482.9	1,114	71.8	1,994	128.6	0.86	111	1,784
Lazio	6,309	107.3	389	6.6	1,464	24.9	0.87	22	141
Marche	6,111	400.7	879	57.6	808	53.0	0.89	47	723
Campania	4,331	74.7	345	5.9	727	12.5	0.86	11	90
Puglia	3,948	98.0	399	9.9	959	23.8	0.74	18	202
Trento	3,894	363.2	405	37.8	841	78.4	0.83	65	1,462
Sicilia	3,055	61.1	228	4.6	639	12.8	0.96	12	101
Friuli Venezia Giulia	2,917	240.0	264	21.7	486	40.0	0.84	34	316
Abruzzo	2,859	218.0	295	22.5	699	53.3	0.59	32	343
Bolzano	2,481	2,309.3	269	250.4	383	356.5	0.52	185	455
Umbria	1,368	155.1	64	7.3	49	5.6	0.65	4	ND
Sardegna	1,280	78.1	109	6.6	167	10.2	0.53	5	50
Valle d'Aosta	1,106	880.5	131	104.3	185	147.3	0.20	30	368
Calabria	1,089	55.9	80	4.1	166	8.5	0.79	7	ND
Basilicata	366	65.0	25	4.4	51	9.1	1.33	12	ND
Molise	296	96.9	21	6.9	39	12.8	0.63	8	ND

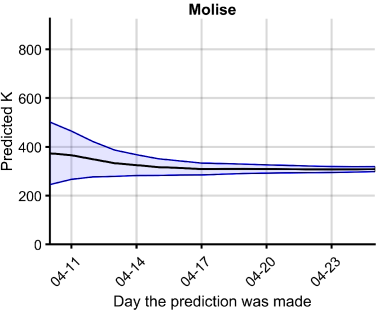
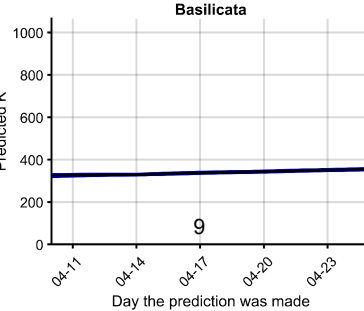
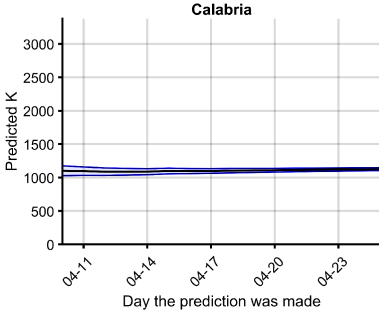
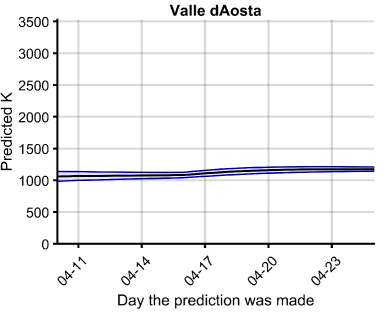
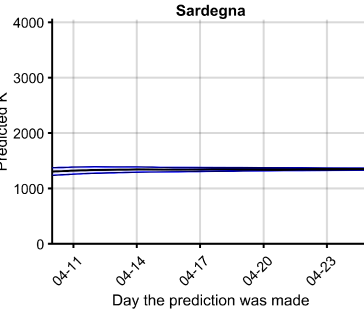
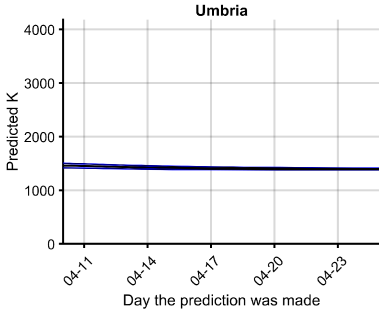
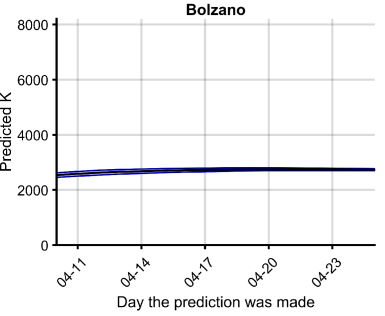
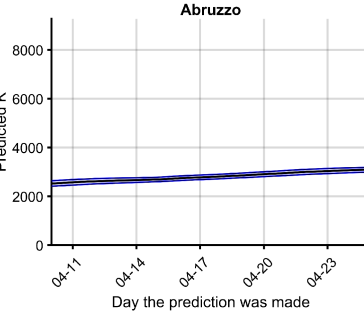
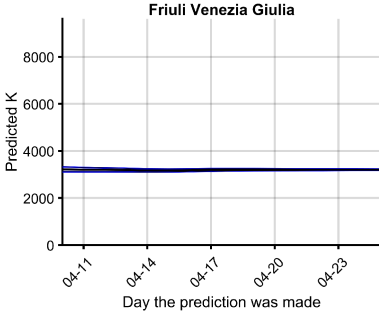
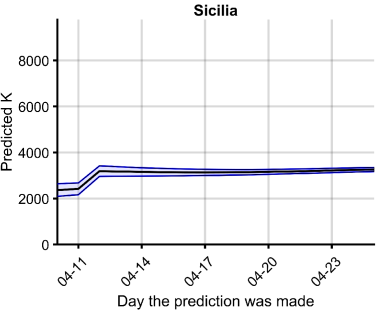
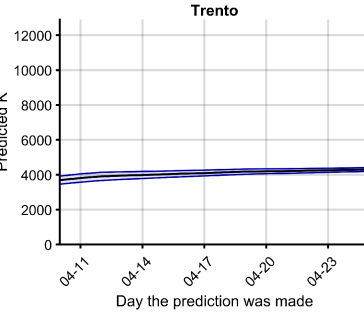
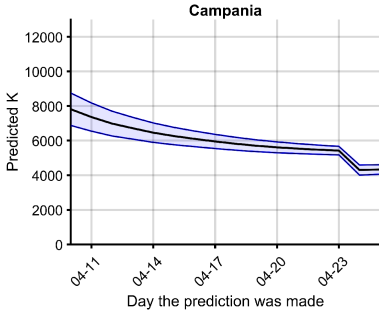
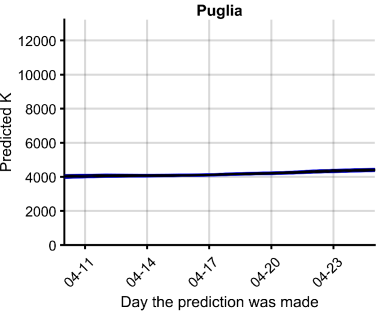
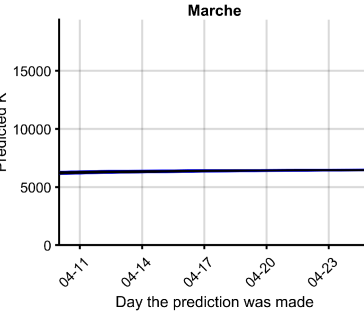
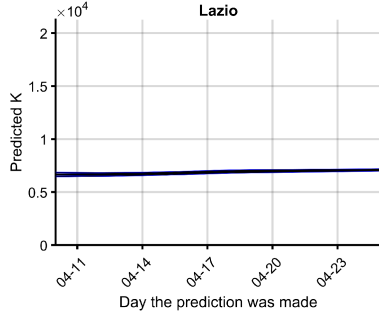
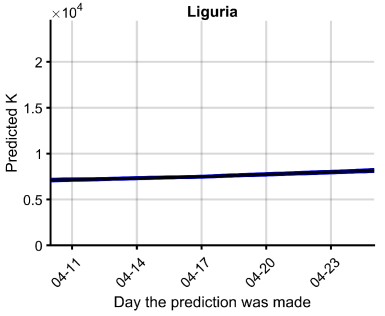
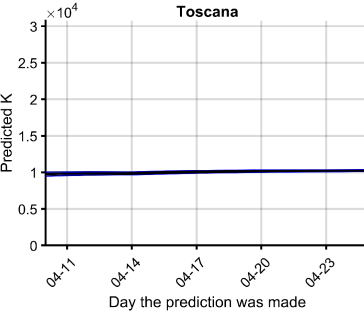
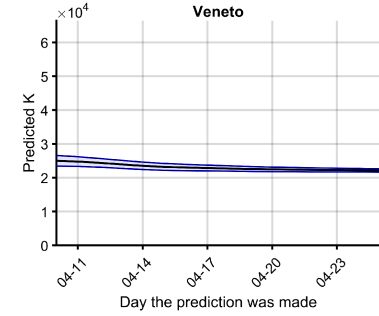
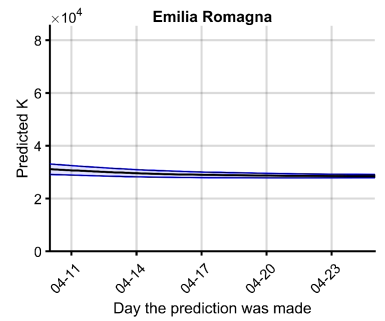
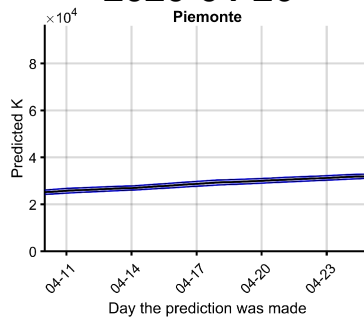
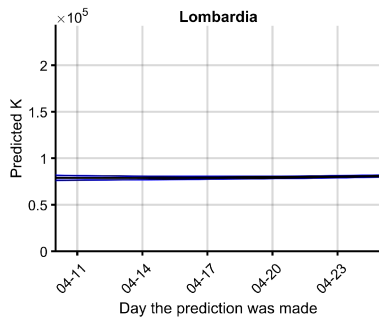
Scale						2.0	500	2500
Worst	Worst	Worst	Worst	Worst	Worst			
Best	Best	Best	Best	Best	Best	0.0	0	0

<sup>(1)</sup> Disclaimer: parameter  $\rho$  is very sensitive and experiments daily variations.  $\rho_3$  is the average of 3 consecutive  $\rho$ , but can still fluctuate. <sup>(2)</sup> EPG stands for Effective Growth Potential. EPG<sub>REP</sub> is obtained by multiplying attack rate of last 14 days per 10<sup>5</sup> inhabitants (i.e. density of cases) by  $\rho_3$  (a value related with effective reproduction number and that, therefore, determines the dynamics for subsequent days). EPG<sub>EST</sub> is obtained by multiplying estimated real attack rate of last 14 days per 10<sup>5</sup> inhabitants by  $\rho_3$ .

**Long-term predictions.** These plots show long-term predictions of: new cases' peaks, final incidence value and approximate date when 90% of total final incidence will be reached. In all three cases we are dealing with the evaluation of global dynamics, which requires small changes in methodology: all data points be used instead of last 15 and with equal weight distribution among them. Blue dashed line indicates current timepoint. See details in Report from 11th April 2020.

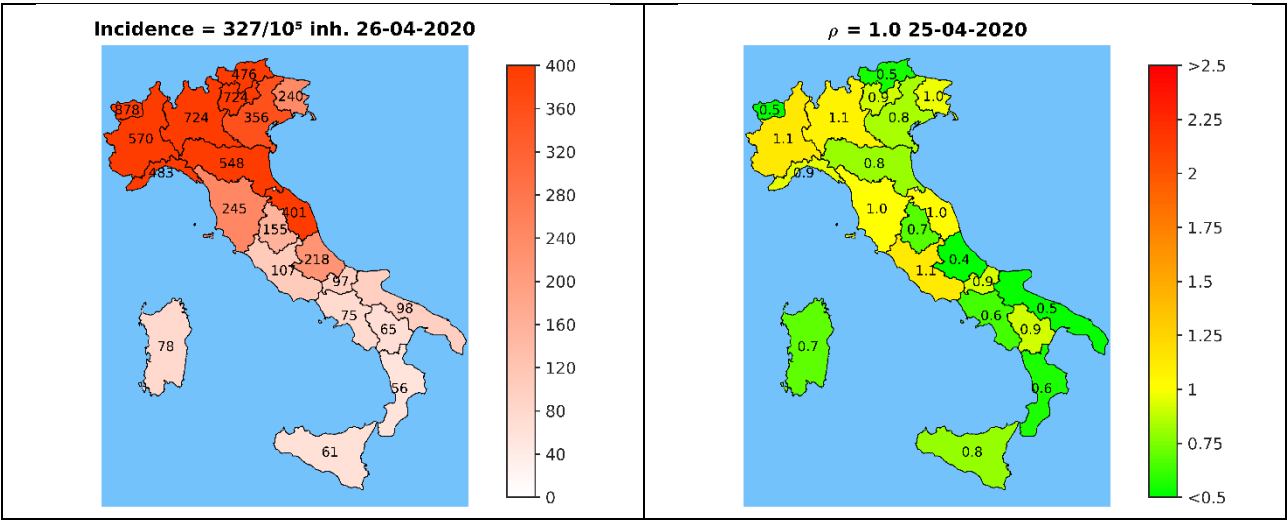


2020-04-26





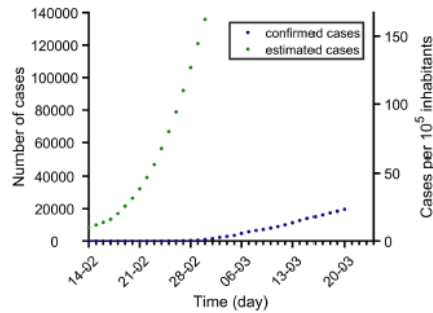
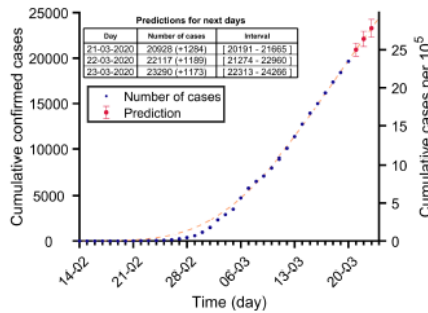
**Maps.** Cumulated incidence and spreading rate ( $\rho$ ) in Italian regions.



## Legend: Countries' reports details

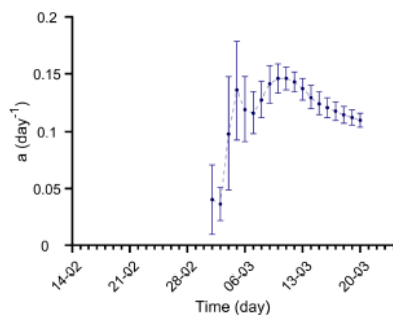
Iran 20-03-2020. Population: 83.7M. Current cumulated incidence:  $23/10^5$

Confirmed cases:  
data (blue),  
model fitted  
(dashed line),  
predictions (red  
points and table)

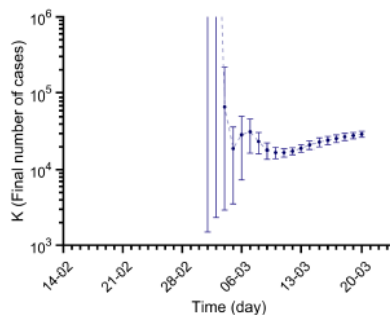


Estimated  
cases using  
death rate (see  
Methods)

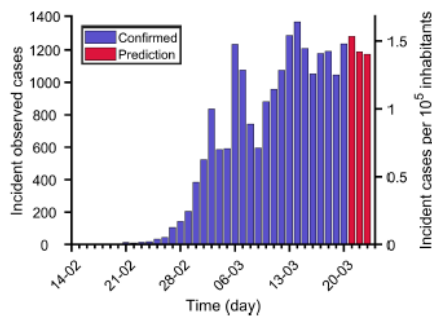
Fitted  $a$  value  
using points  
prior to each  
date



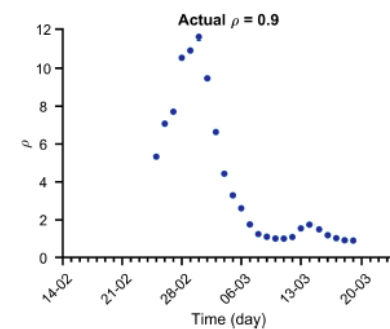
Fitted  $K$  value  
using points  
prior to each  
date



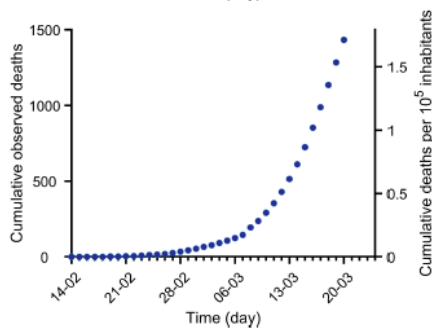
Reported  
and  
predicted  
new cases



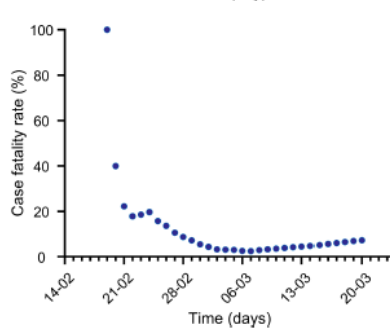
Evolution of  $\rho$ , a  
parameter related  
with Reproduction  
number (see  
Methods)



Reported  
deaths

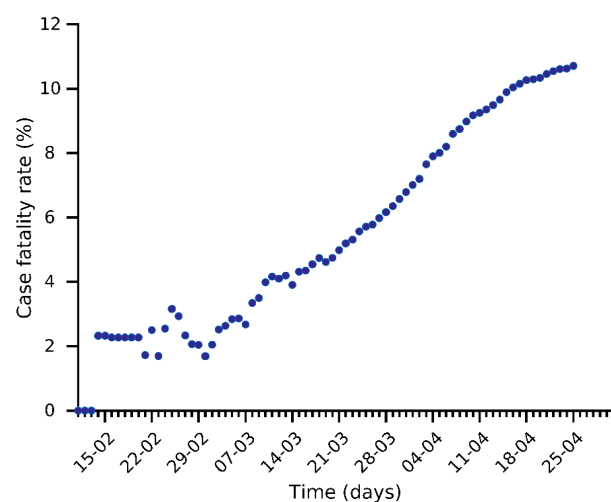
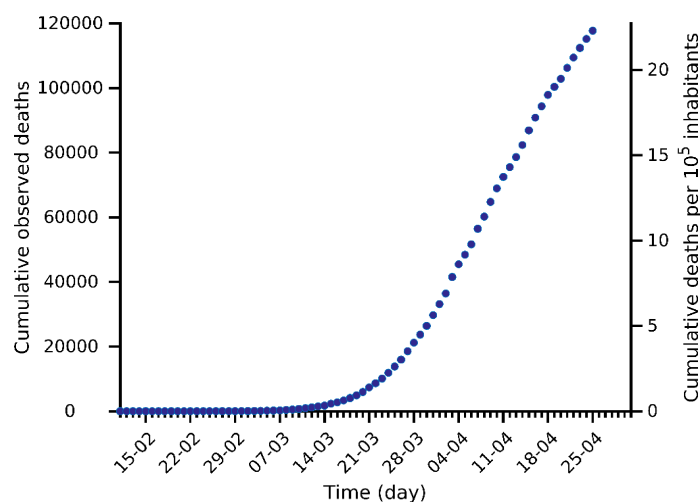
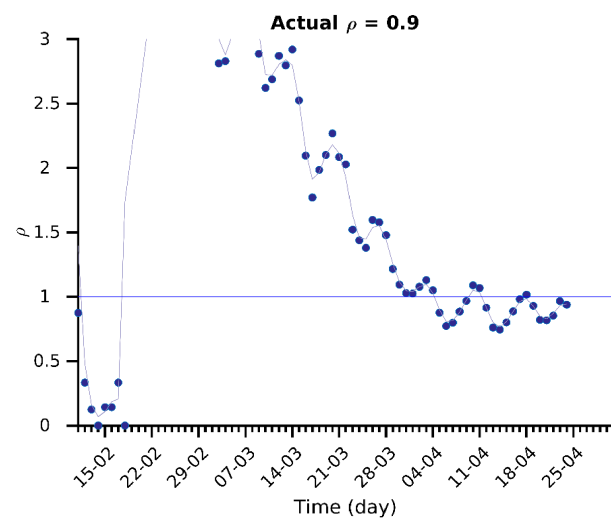
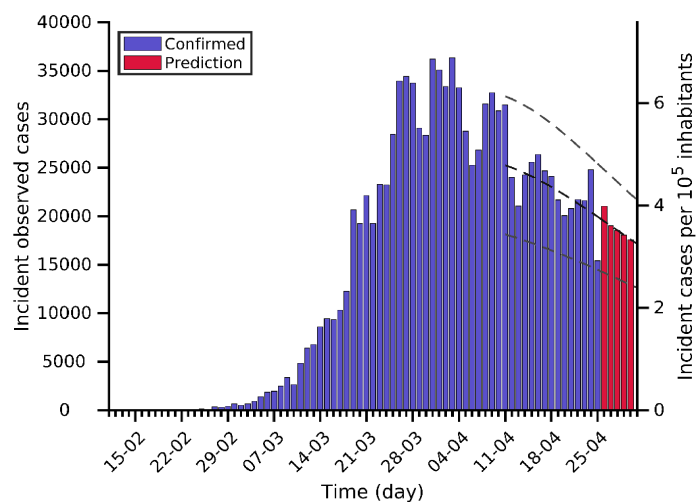
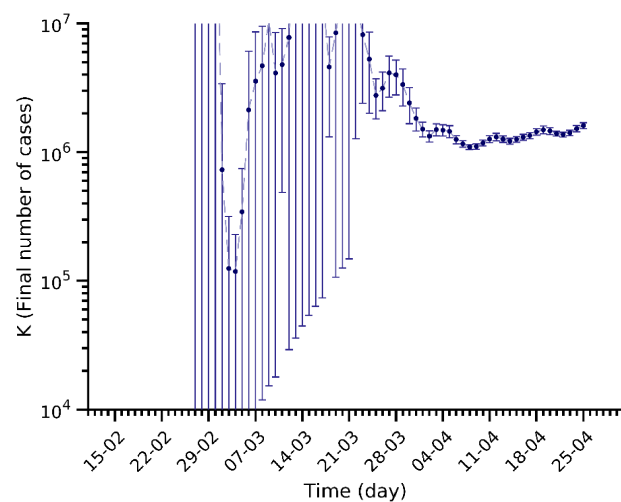
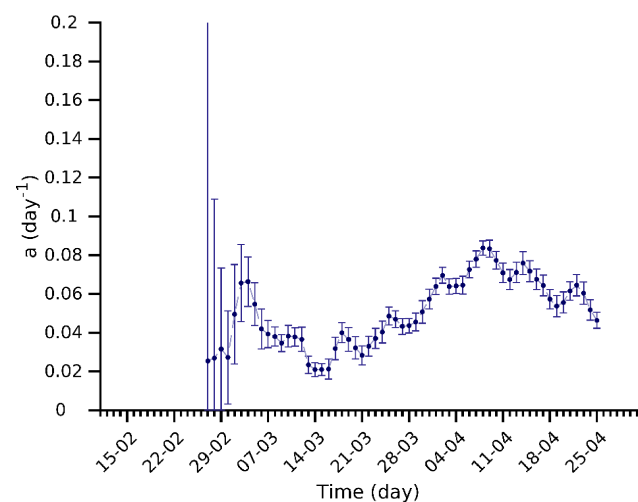
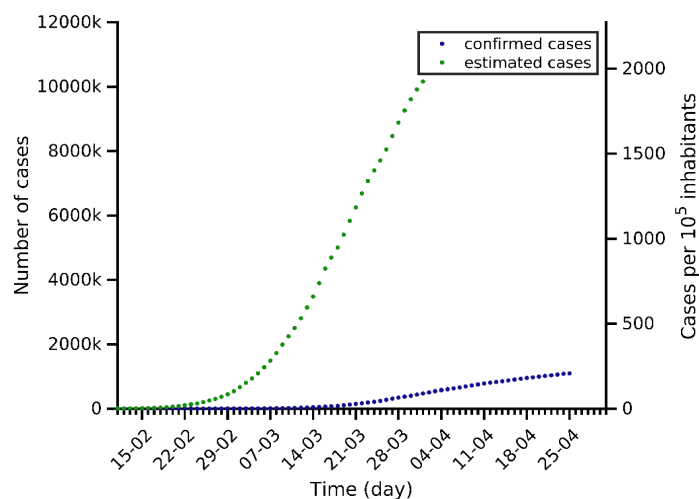
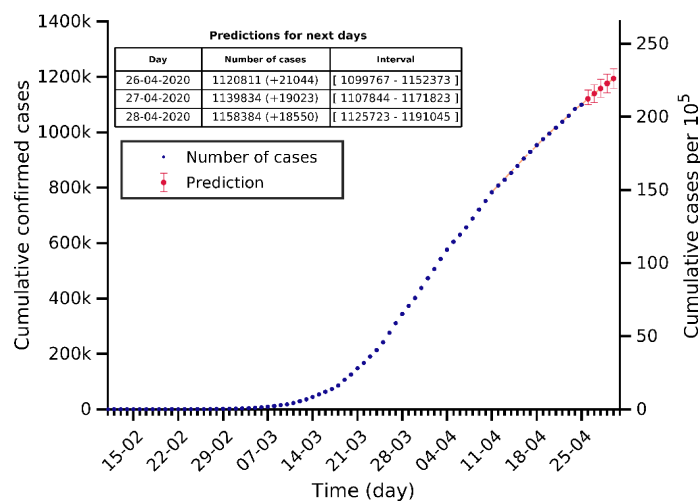


Deaths /  
cumulated  
reported cases

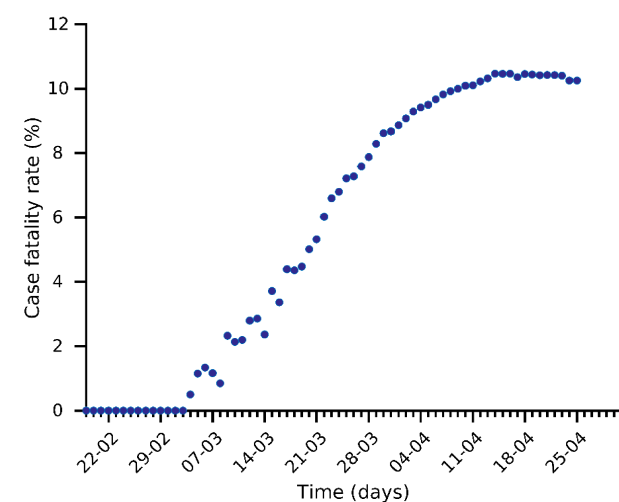
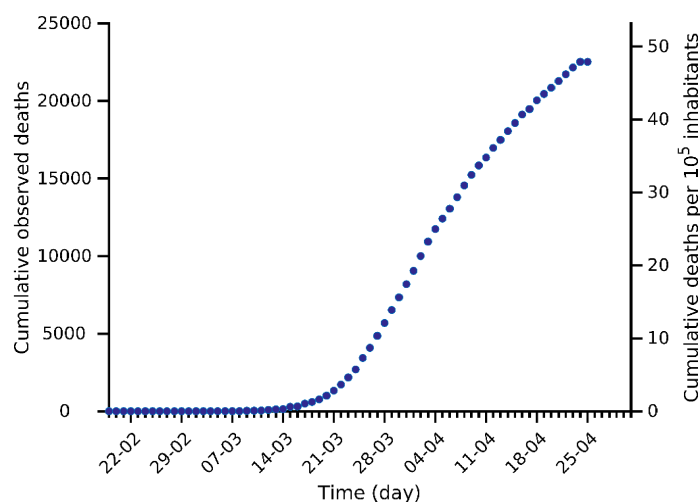
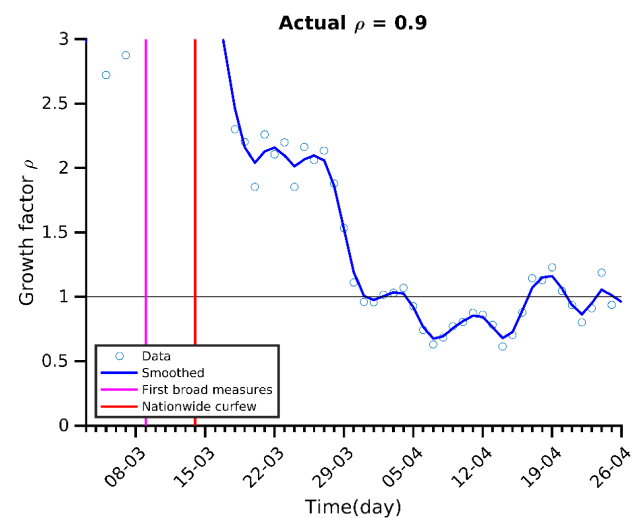
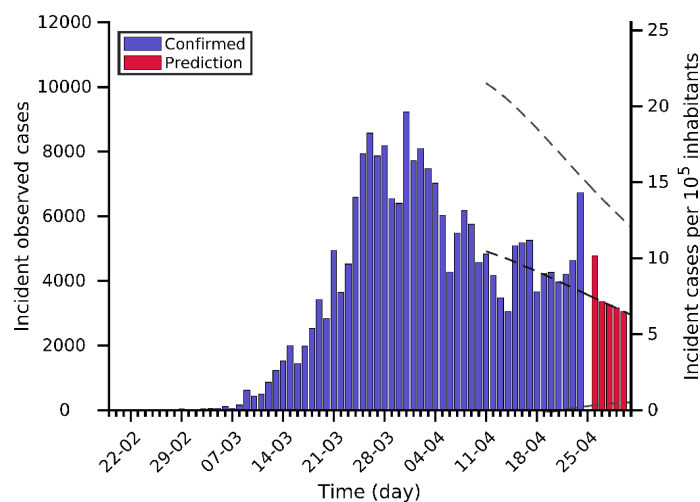
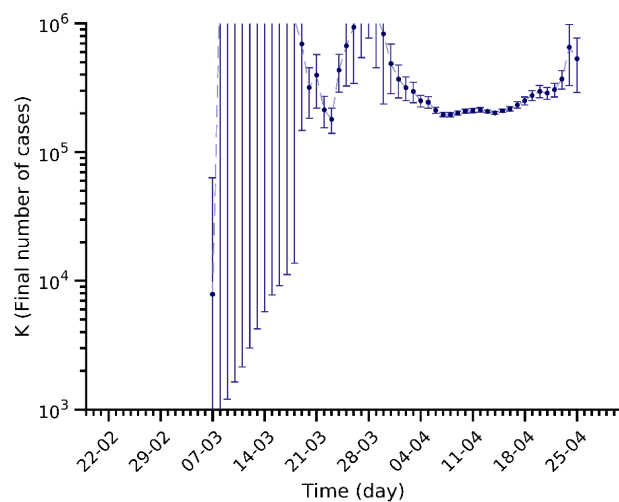
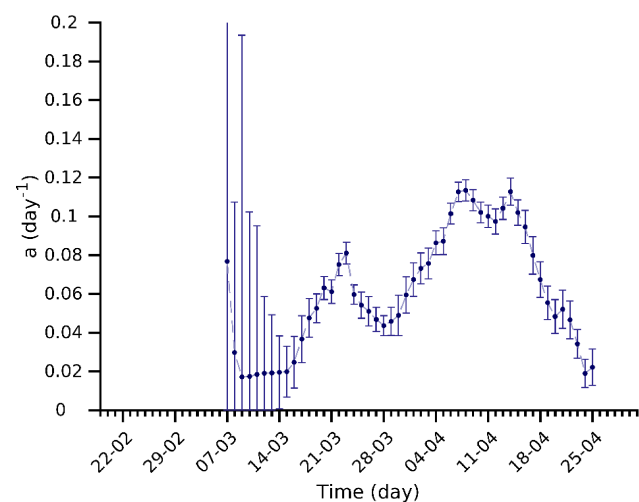
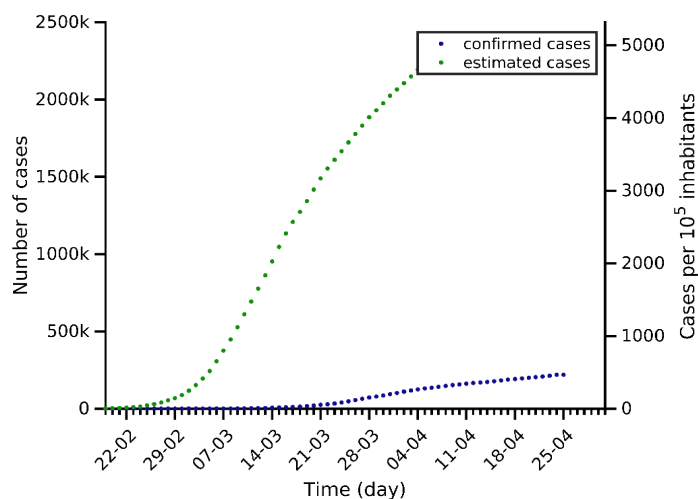
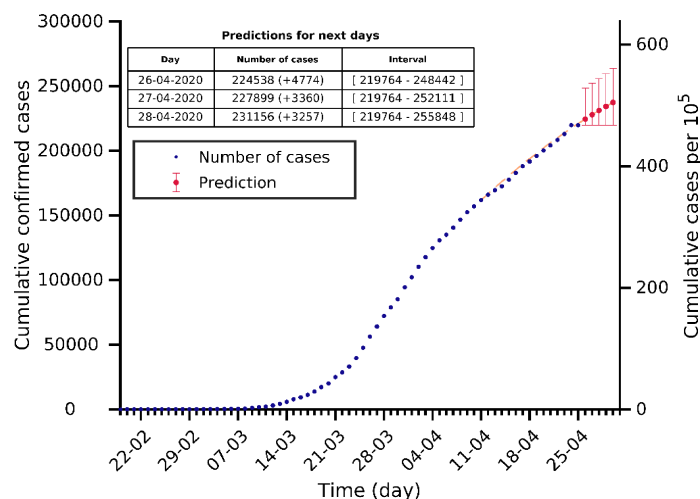


## **(1) Analysis and prediction of COVID-19 for EU+EFTA+UK**

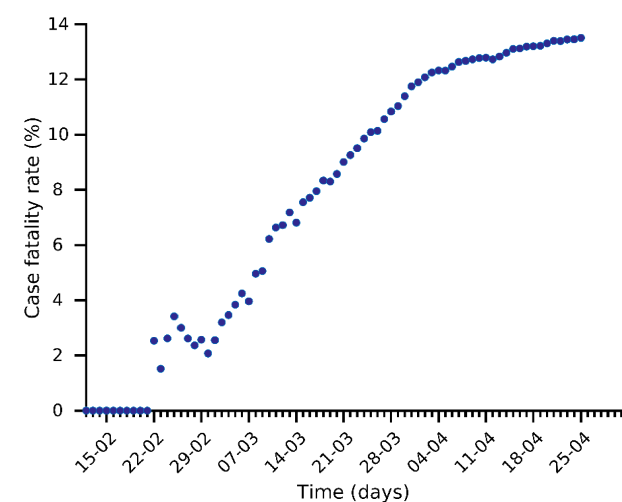
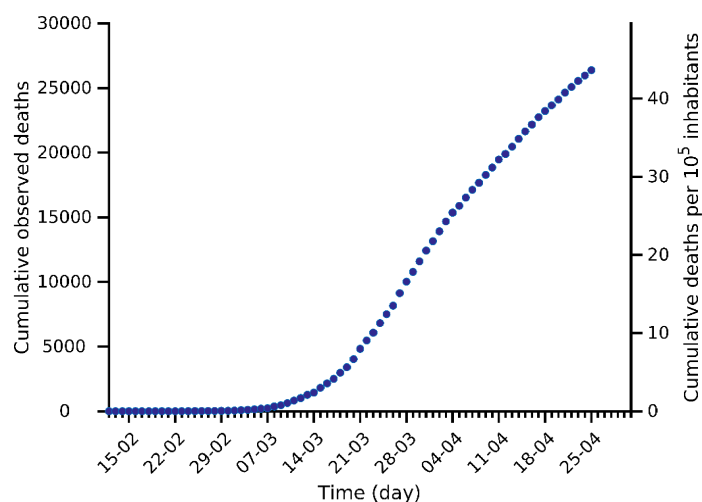
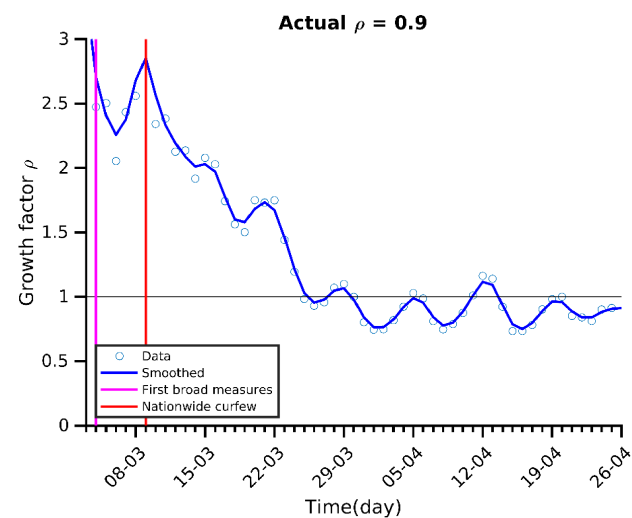
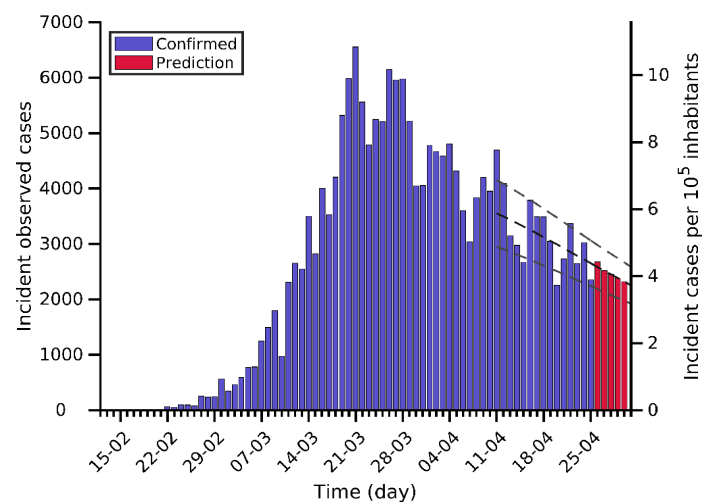
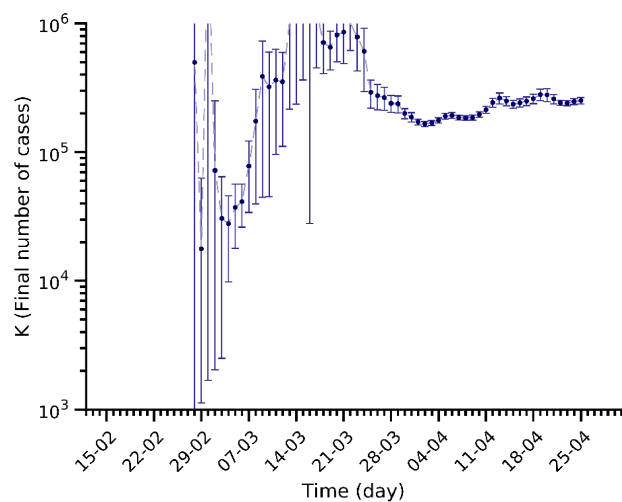
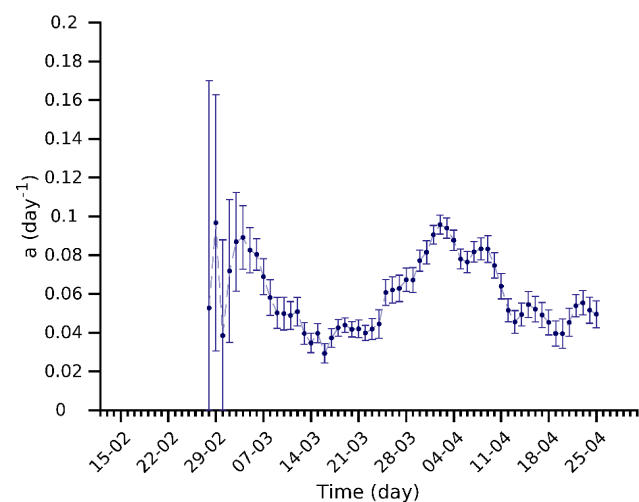
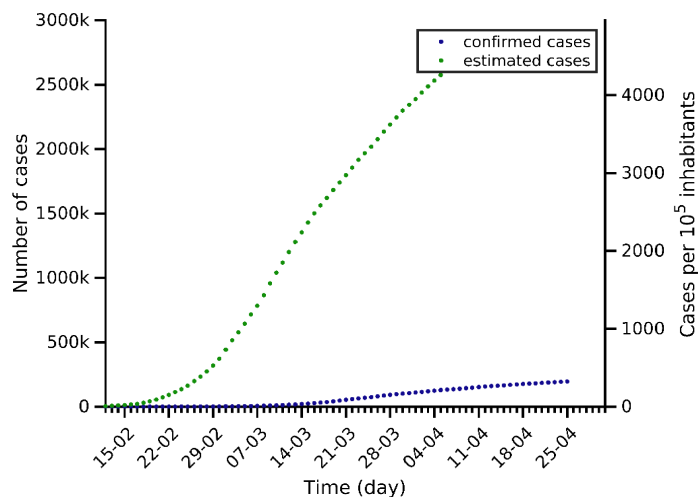
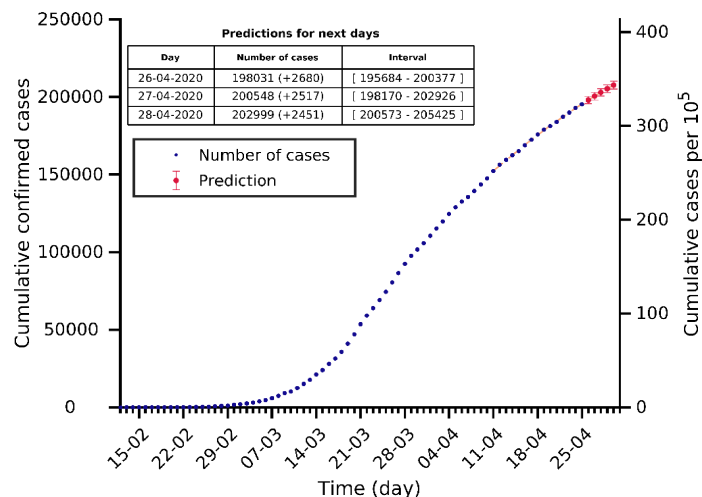
Data obtained from <https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases>  
<https://github.com/pcm-dpc/COVID-19/tree/master/dati-andamento-nazionale> (Italy)



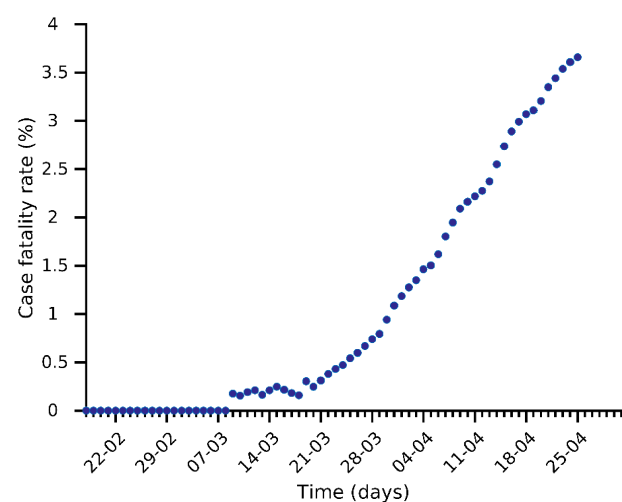
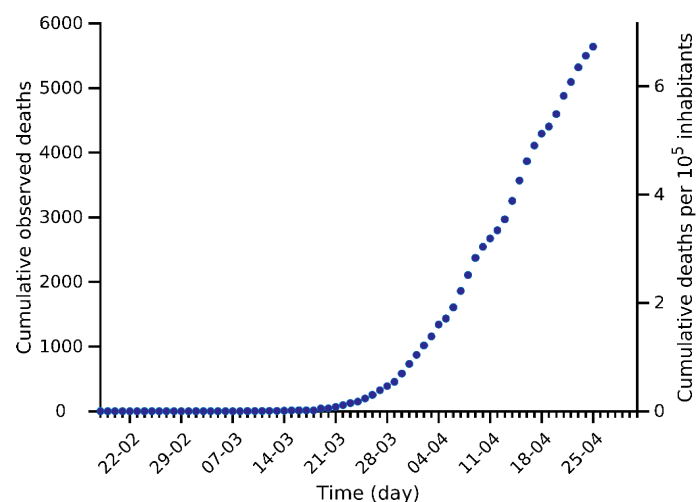
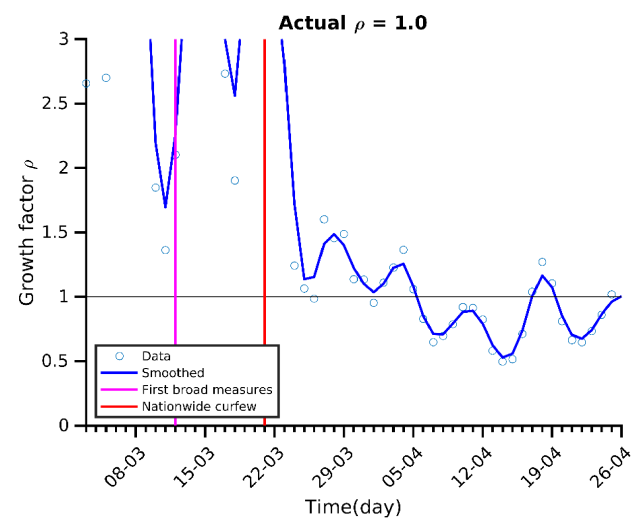
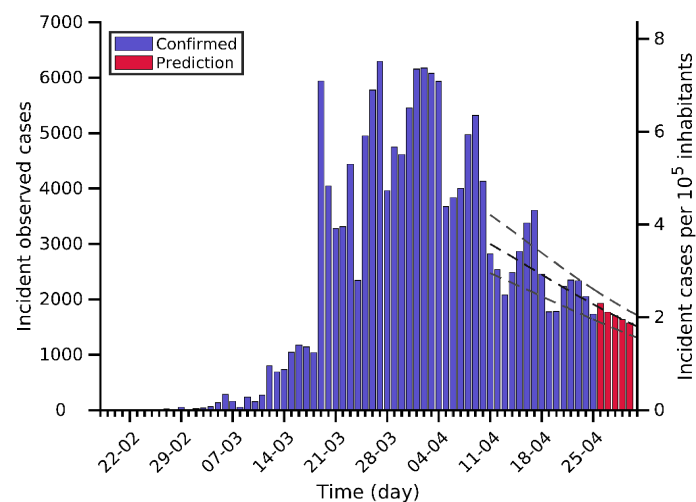
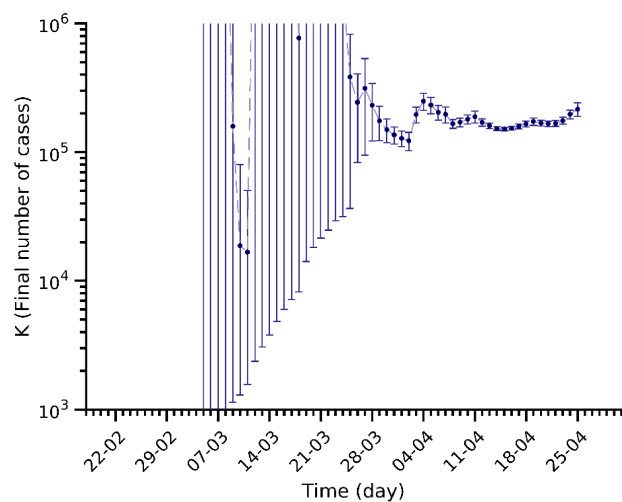
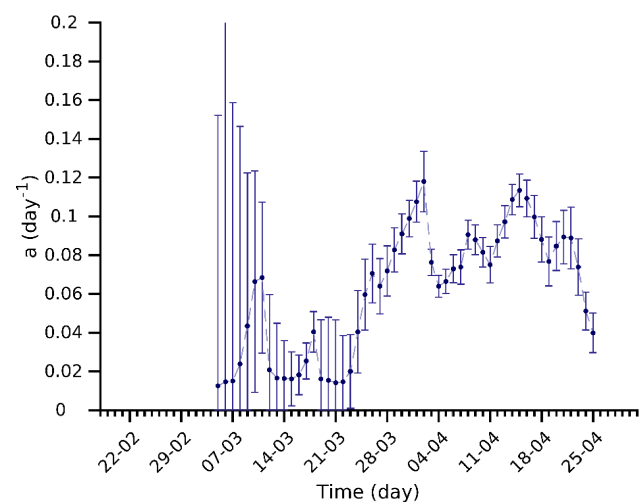
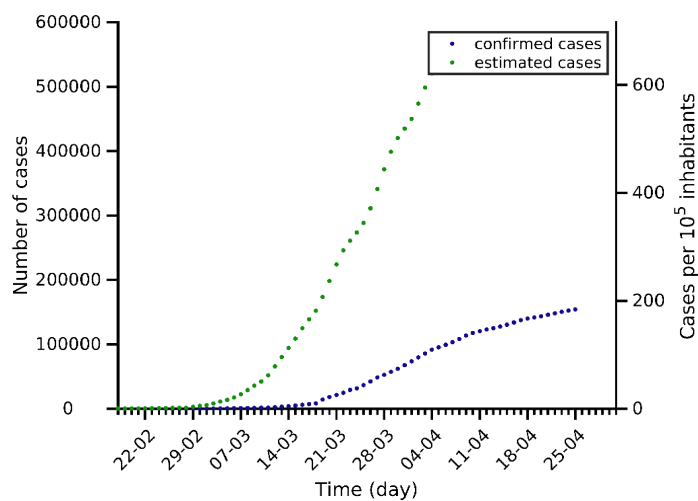
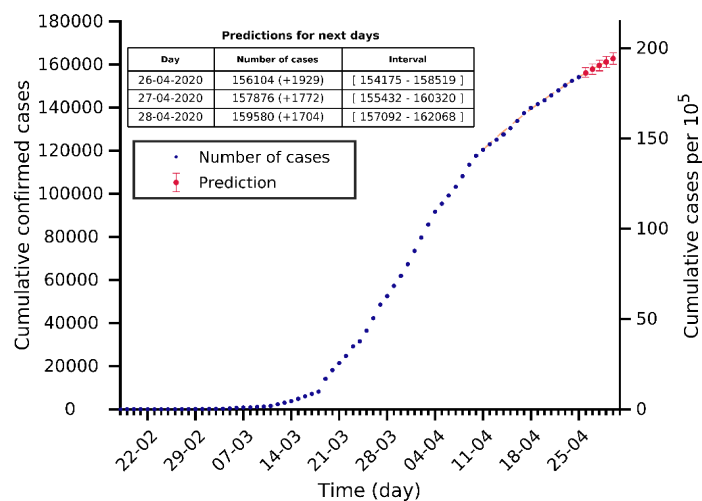
# Spain 25-04-2020. Population: 47.0M. Current cumulated incidence: 467/10<sup>5</sup>



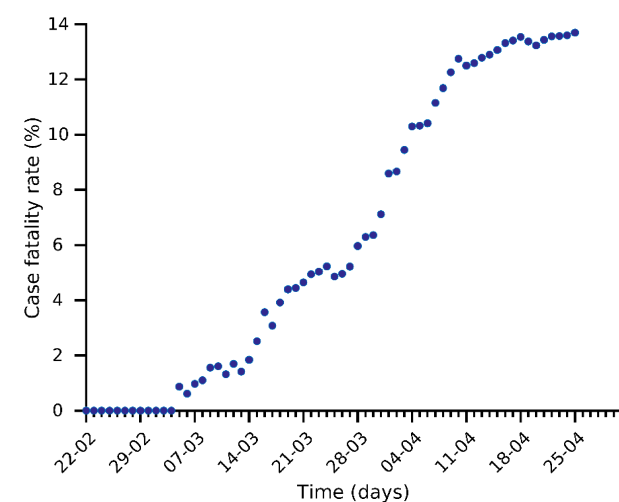
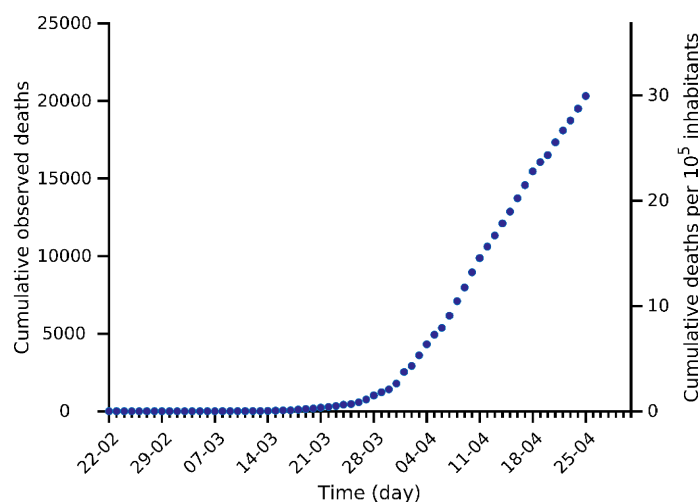
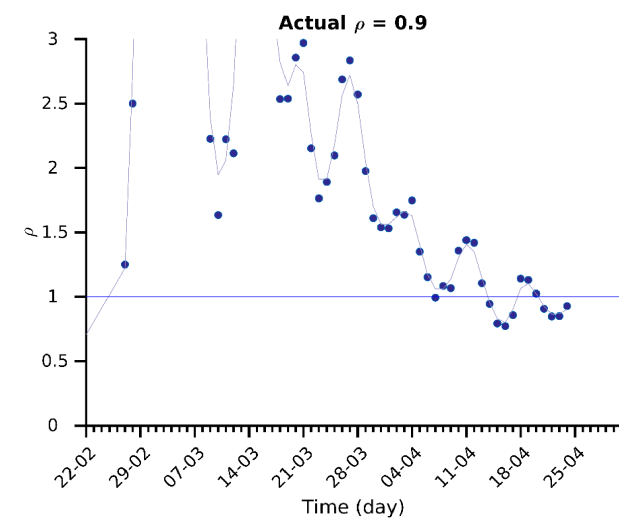
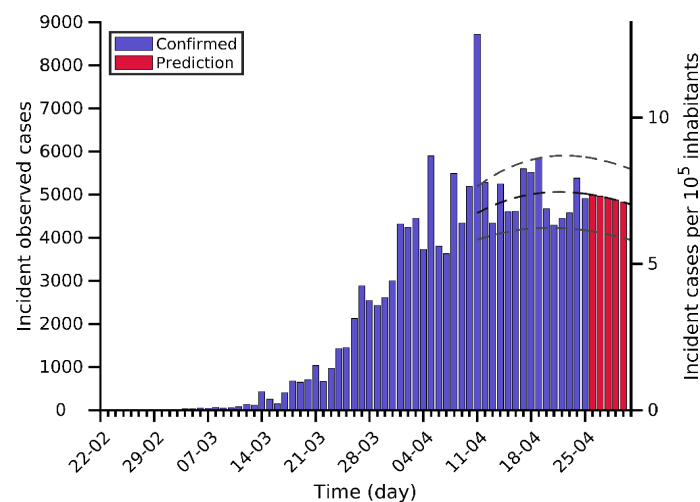
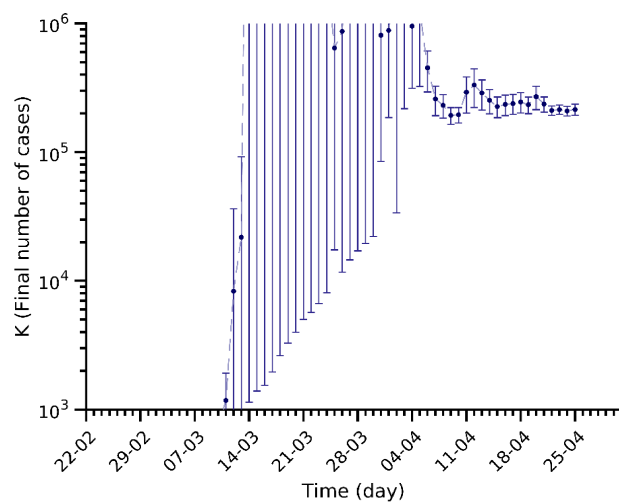
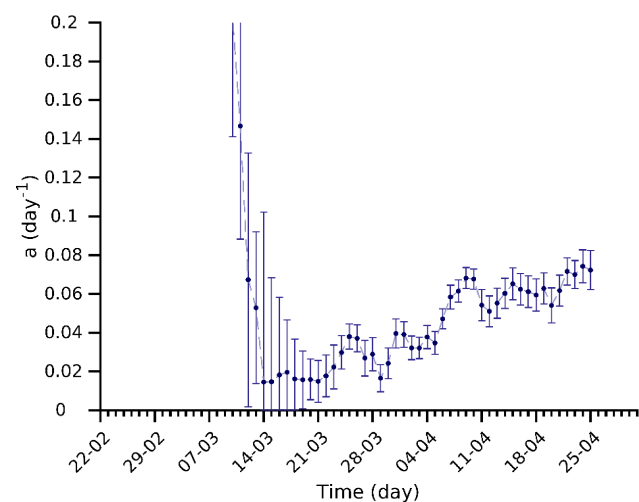
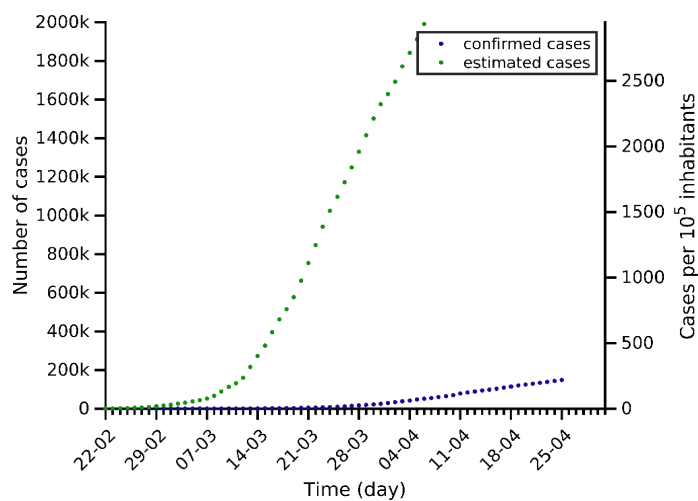
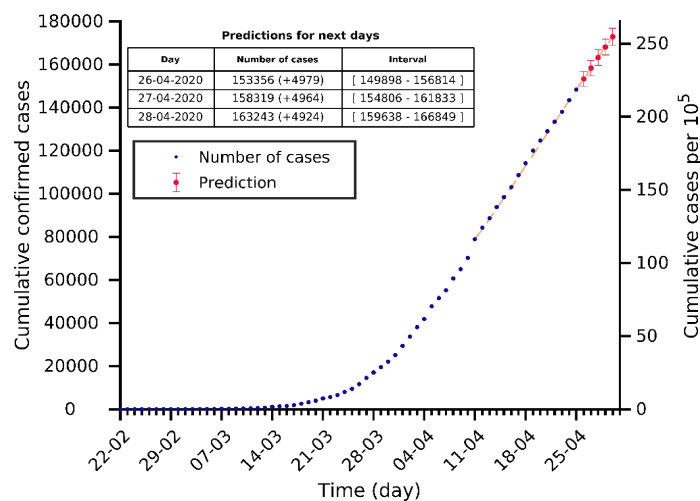
# Italy 25-04-2020. Population: 60.5M. Current cumulated incidence: 323/10<sup>5</sup>



# Germany 25-04-2020. Population: 83.8M. Current cumulated incidence: 184/10<sup>5</sup>

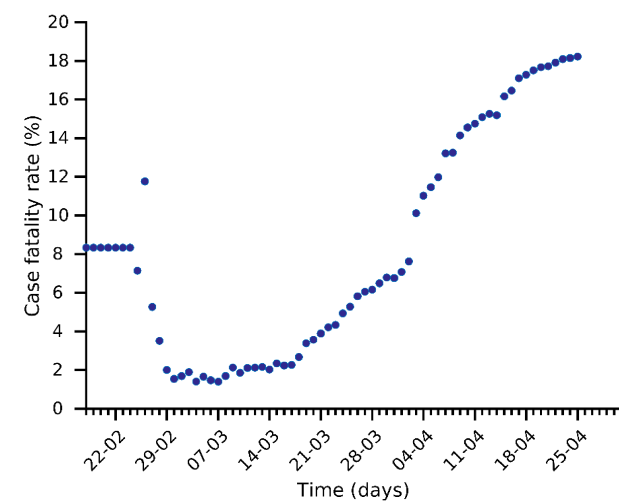
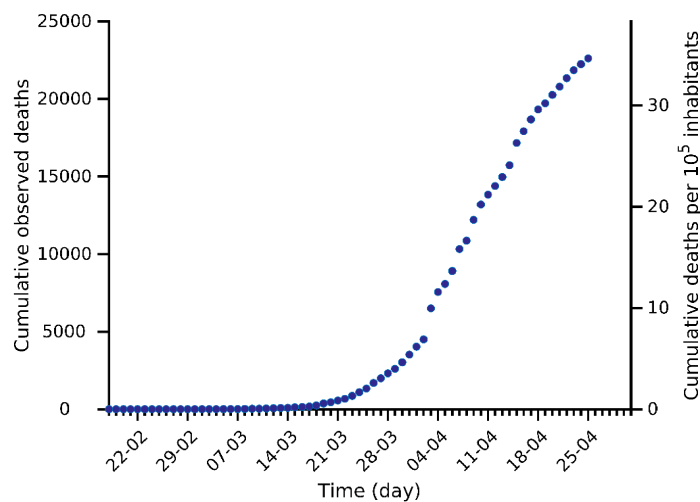
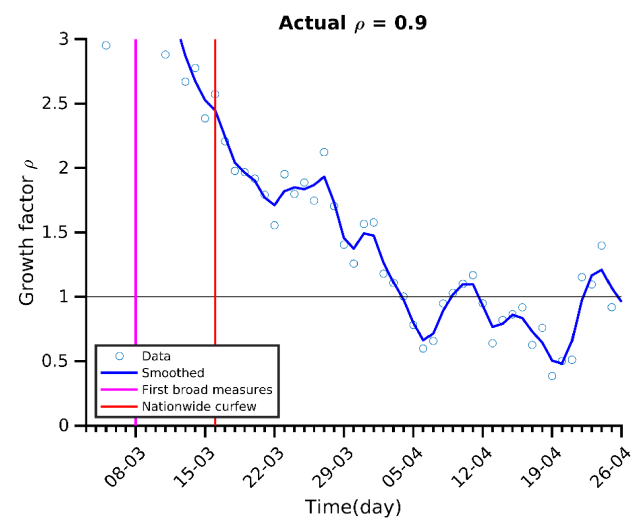
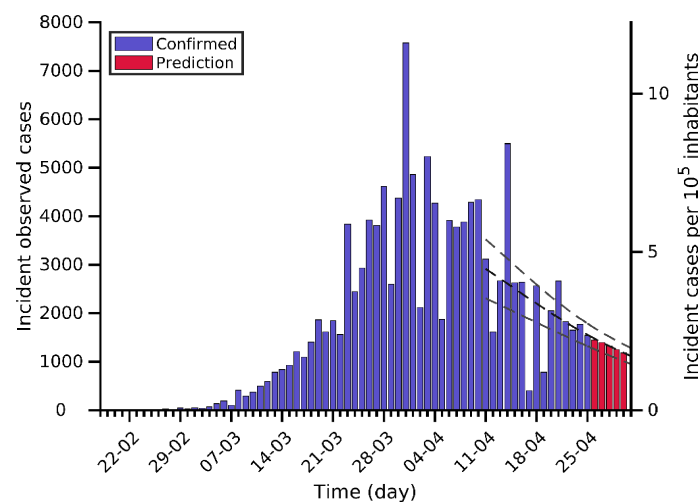
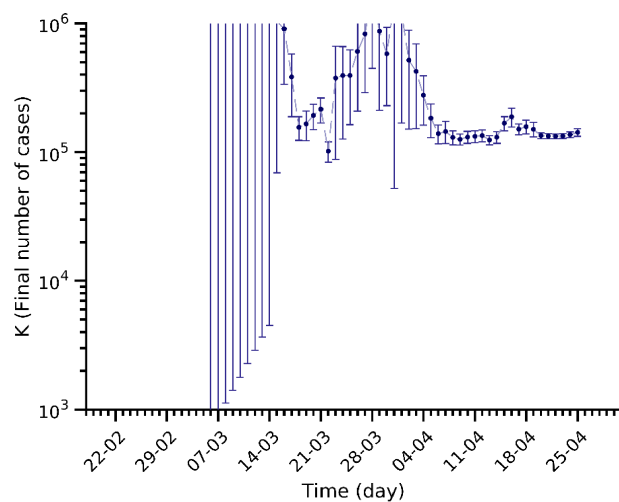
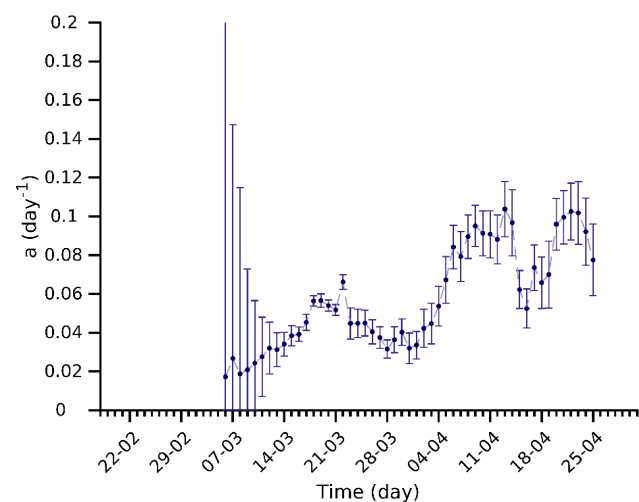
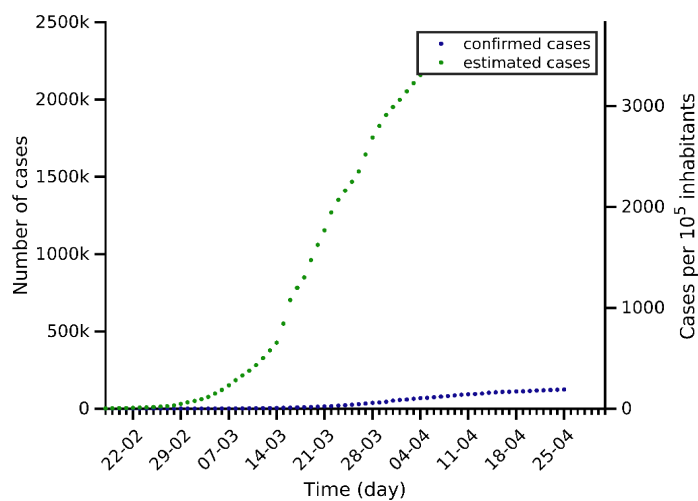
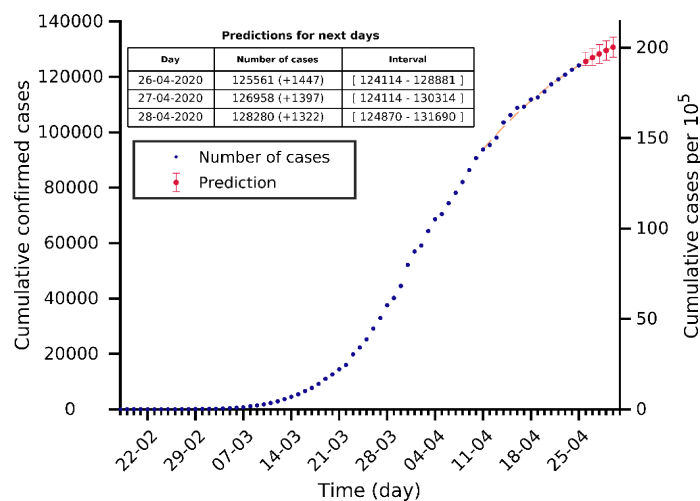


# UK 25-04-2020. Population: 67.9M. Current cumulated incidence: 219/10<sup>5</sup>

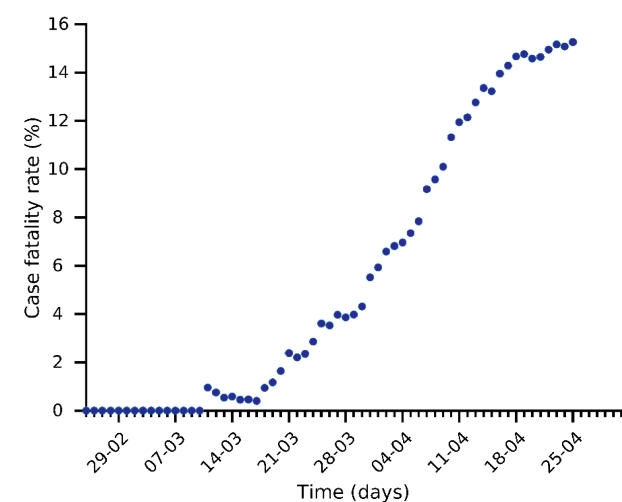
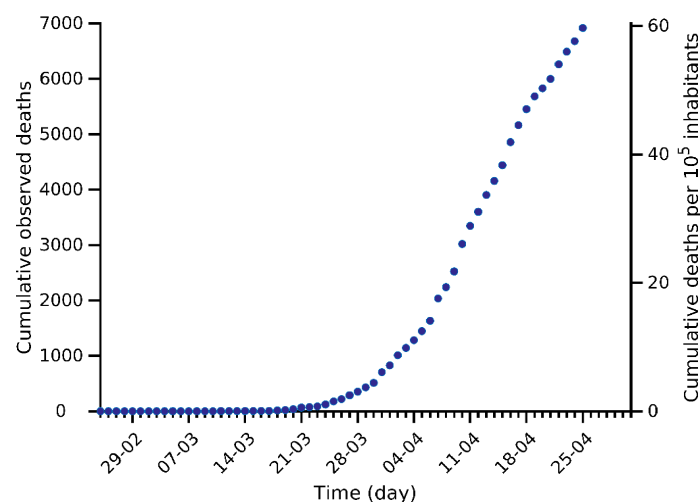
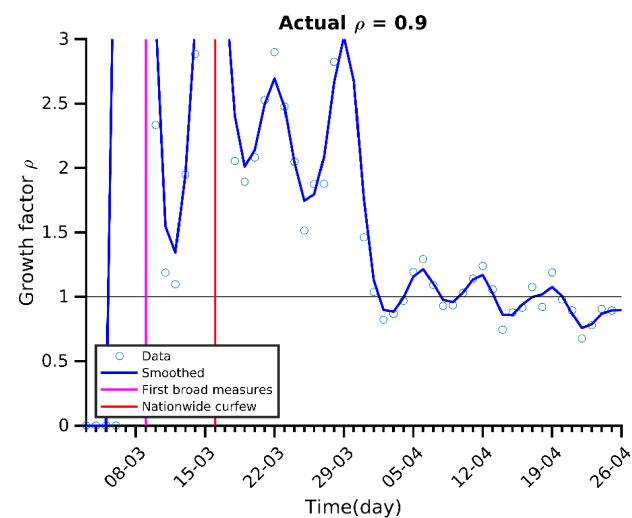
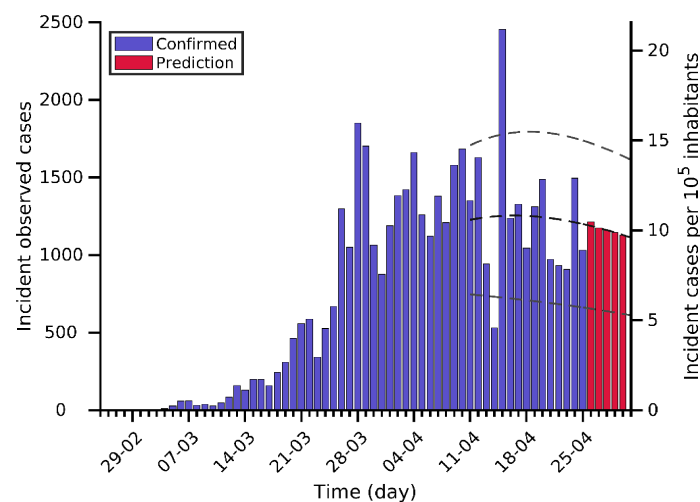
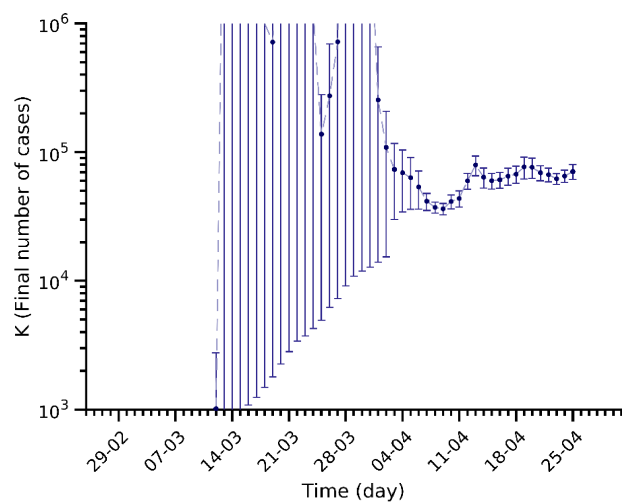
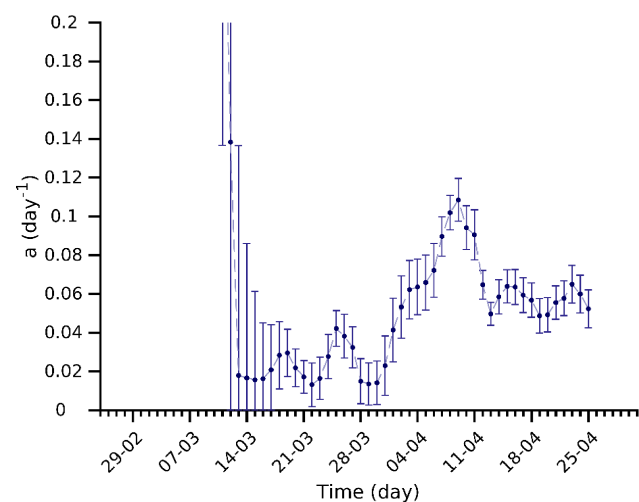
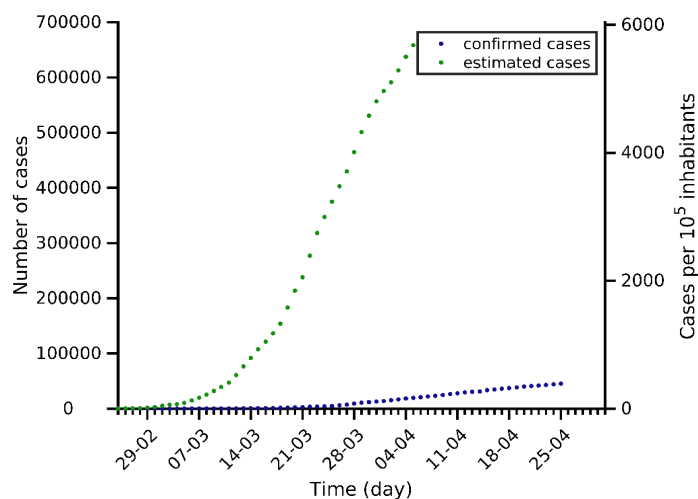
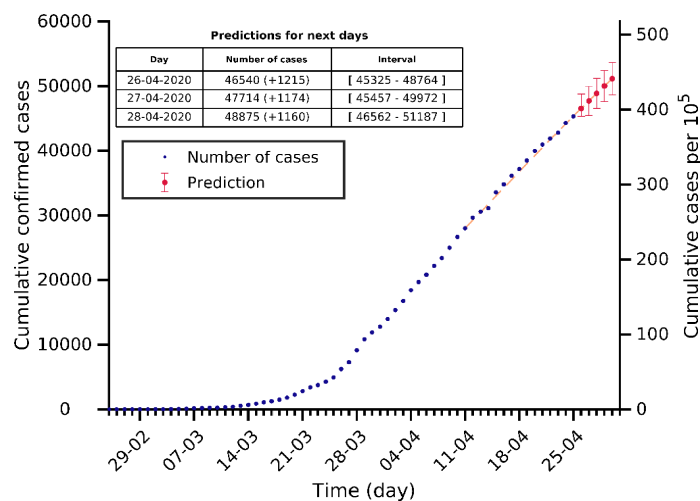




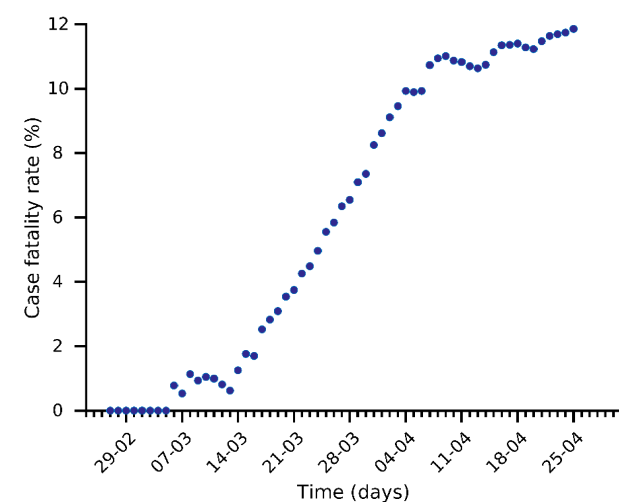
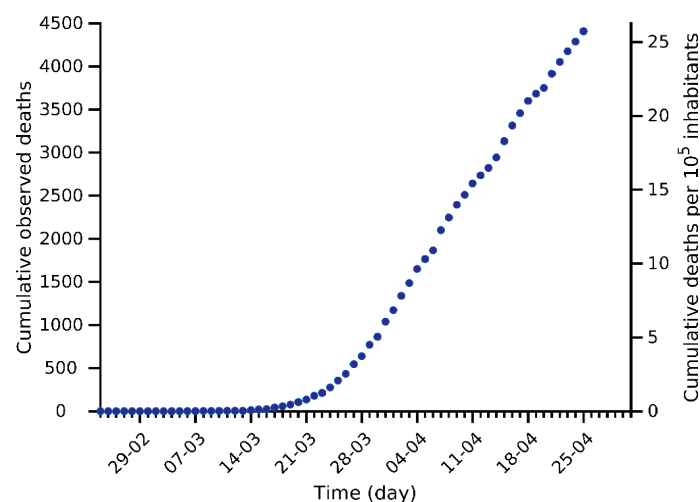
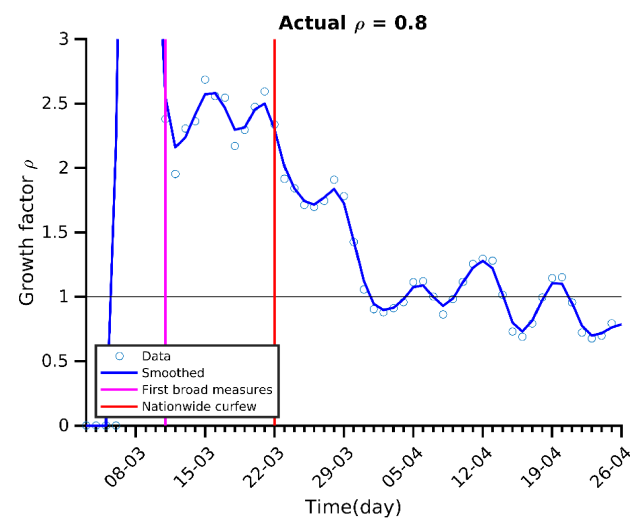
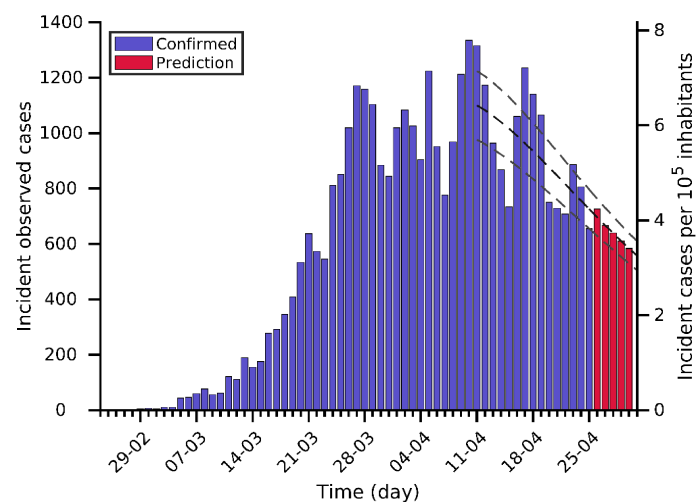
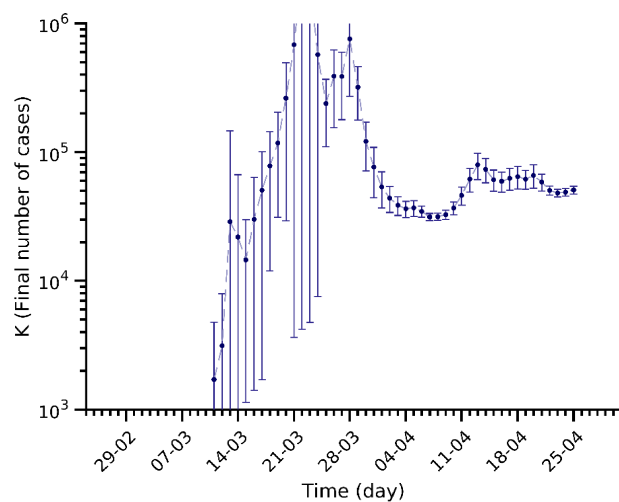
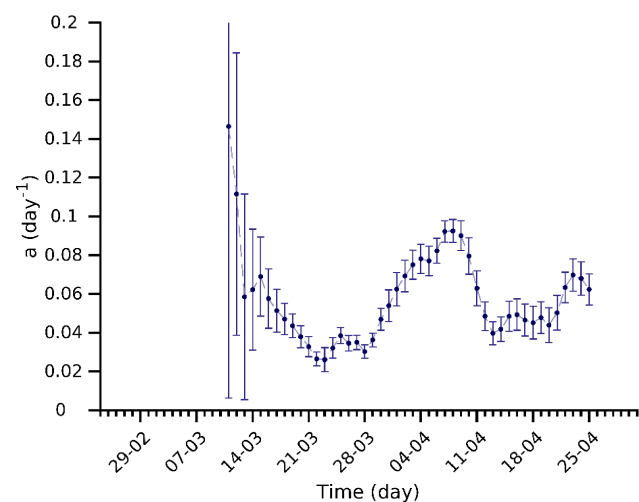
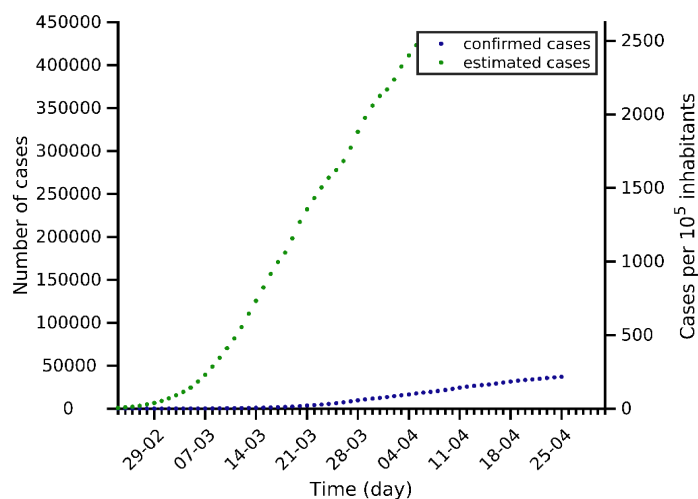
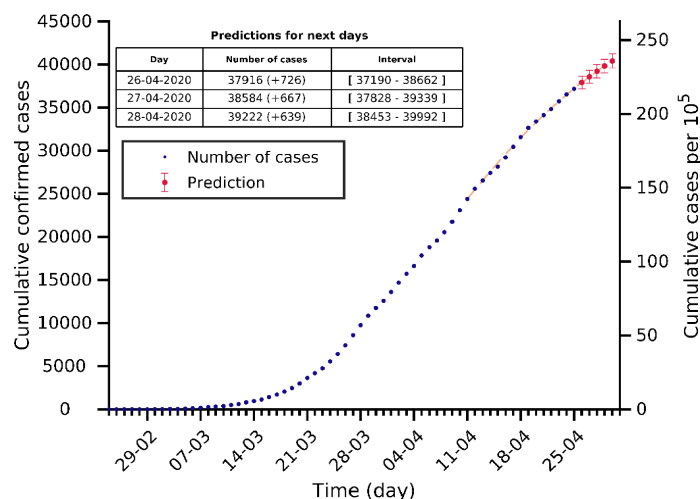
# France 25-04-2020. Population: 65.3M. Current cumulated incidence: 190/10<sup>5</sup>



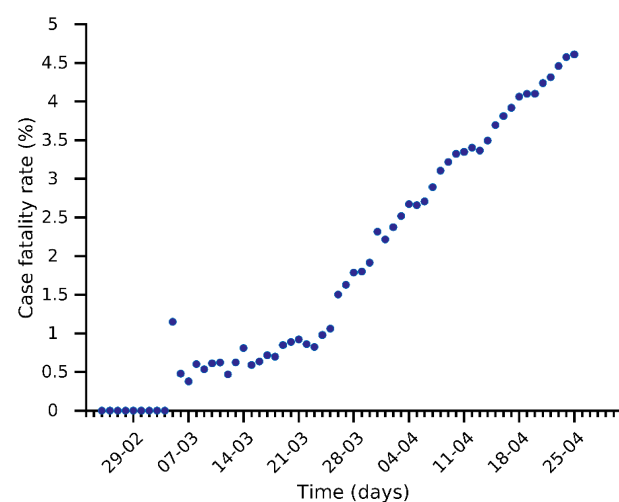
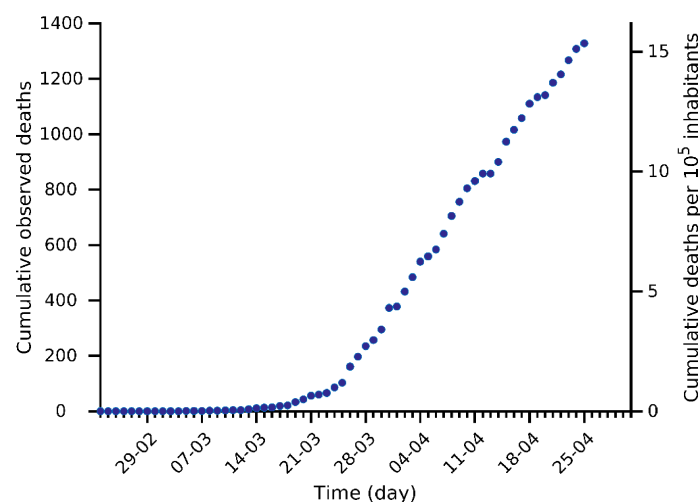
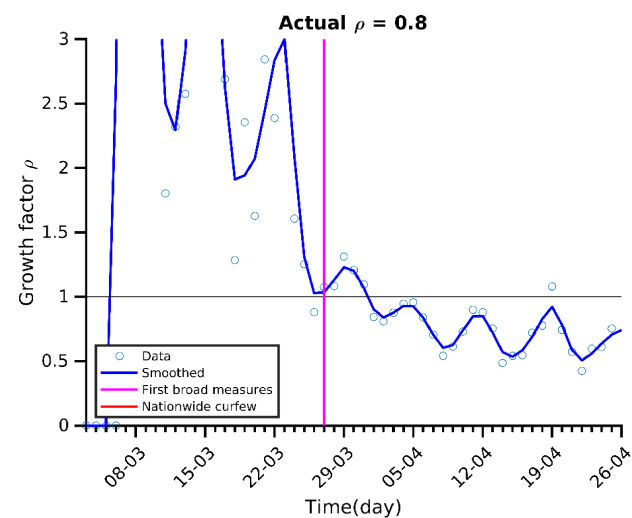
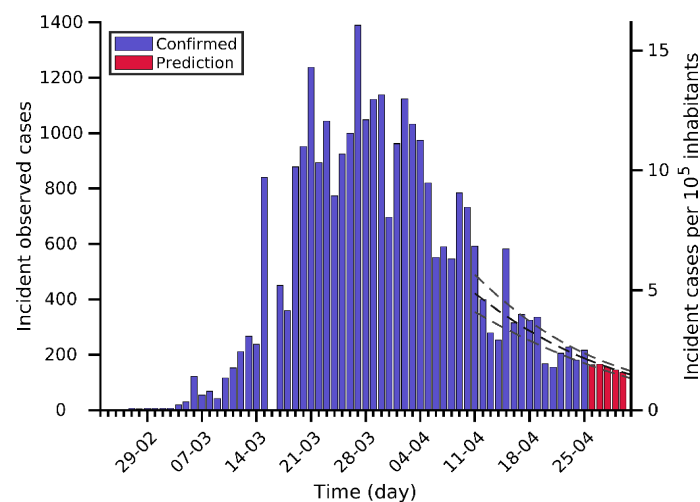
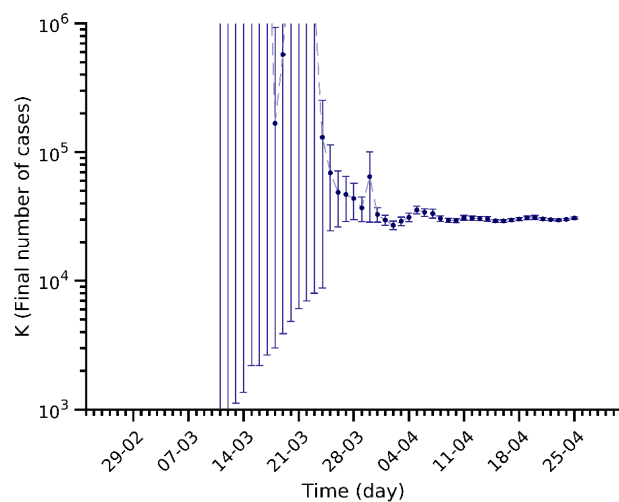
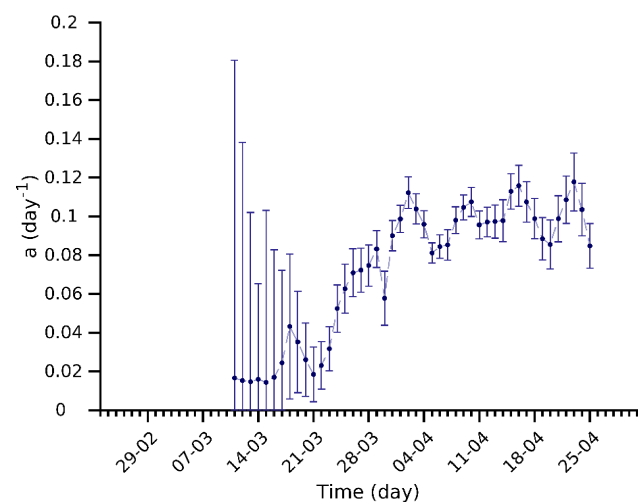
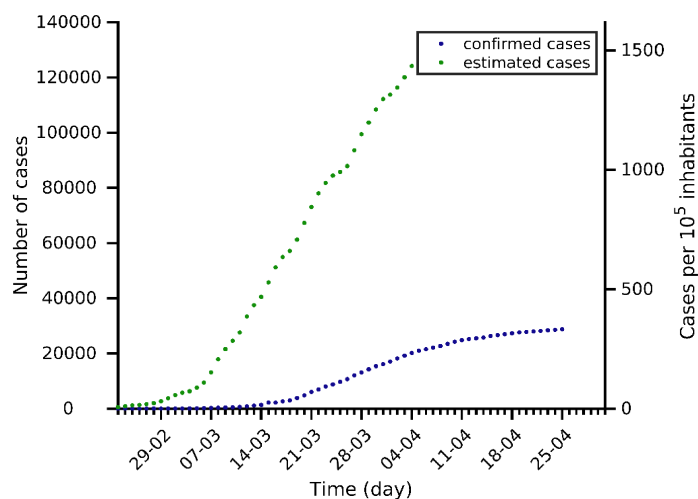
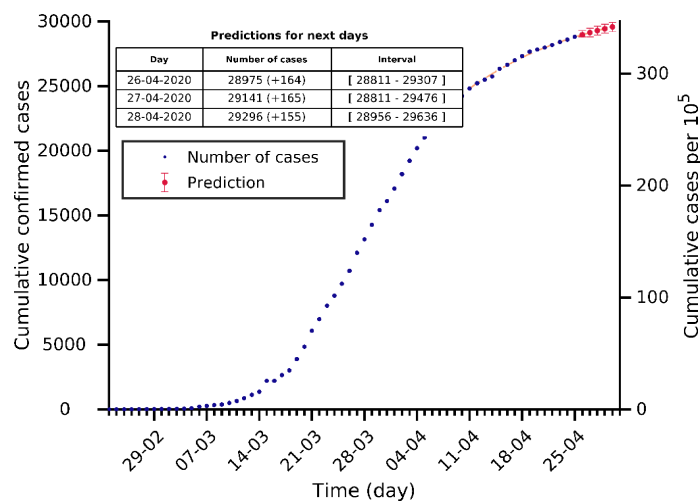
# Belgium 25-04-2020. Population: 11.6M. Current cumulated incidence: 391/10<sup>5</sup>



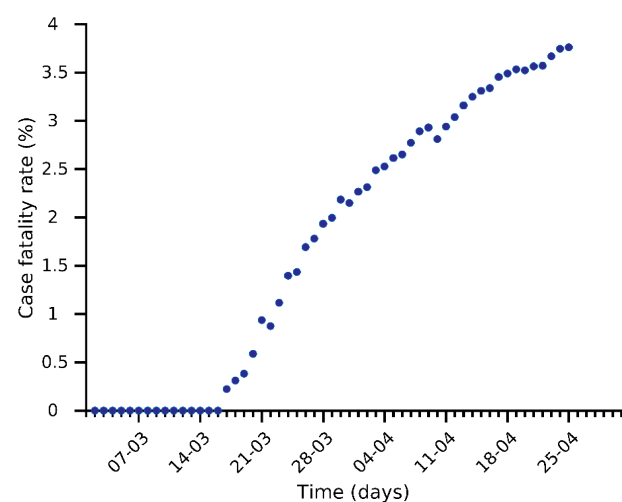
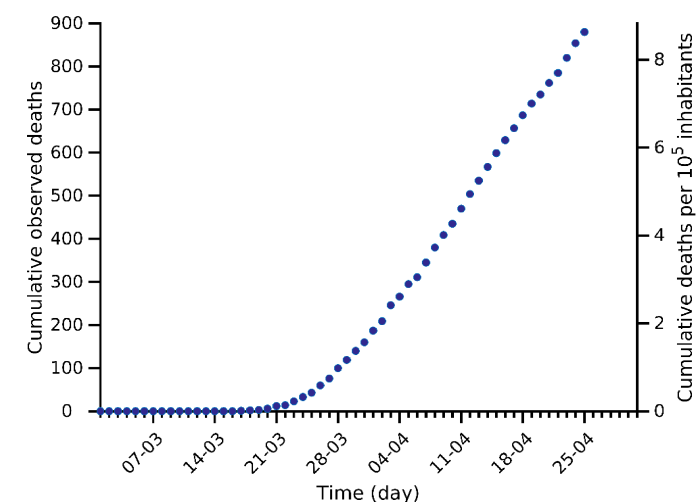
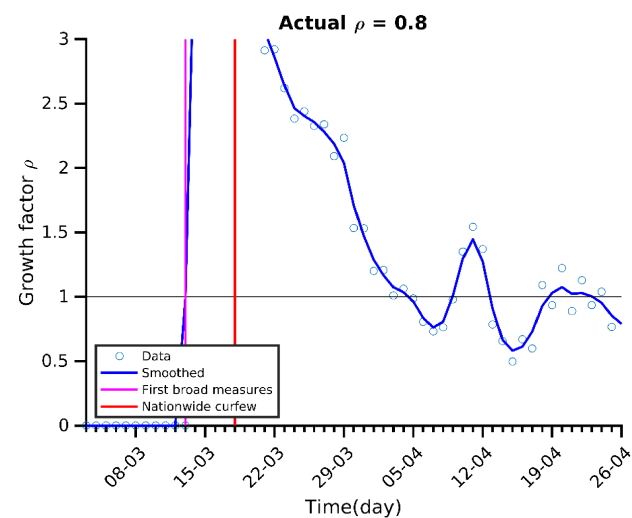
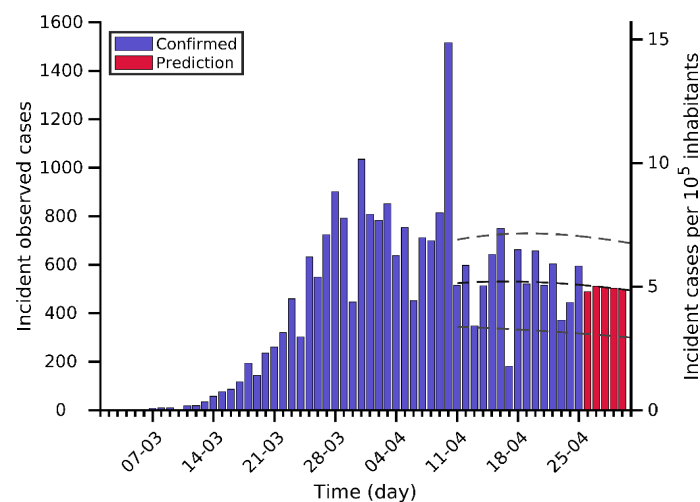
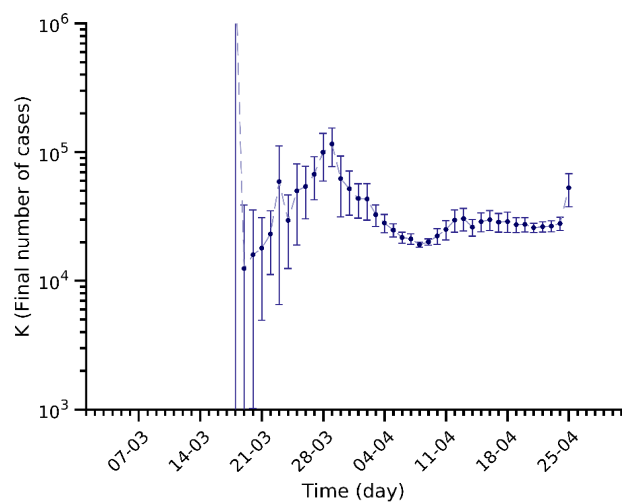
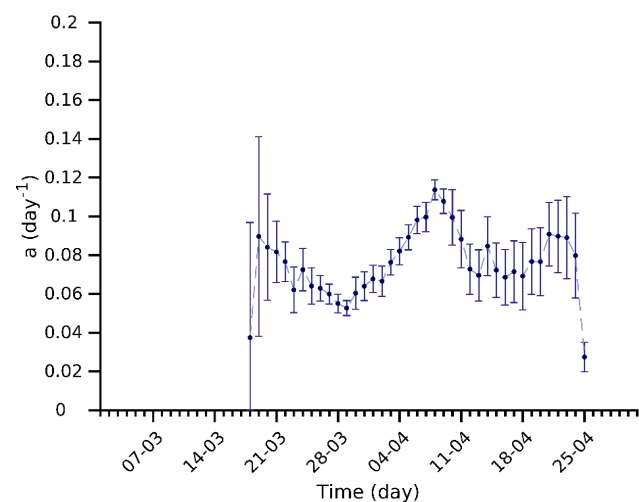
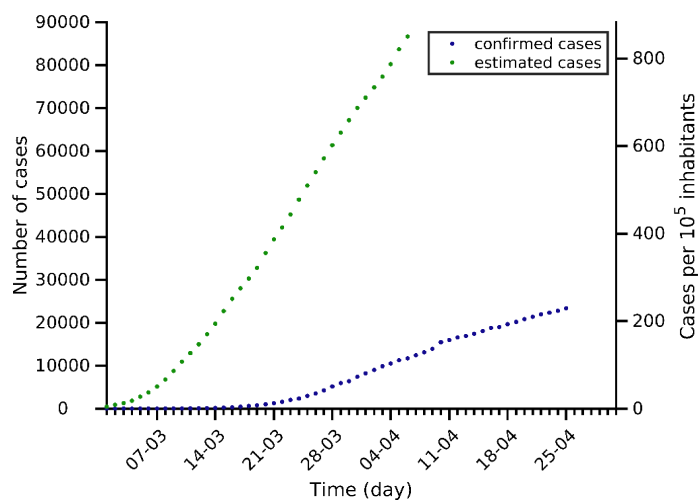
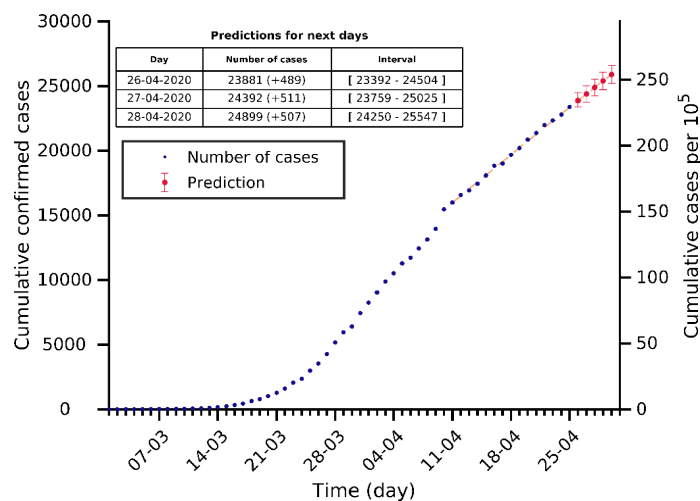
# Netherlands 25-04-2020. Population: 17.1M. Current cumulated incidence: 217/10<sup>5</sup>



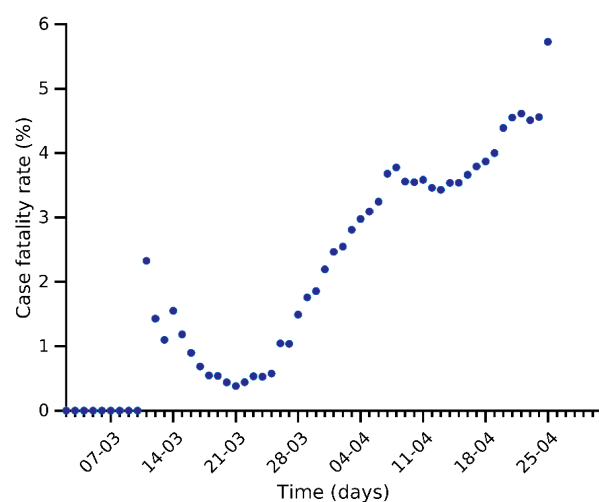
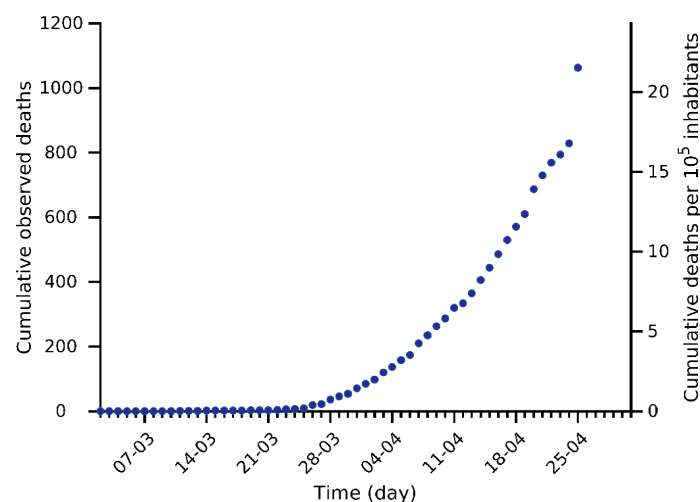
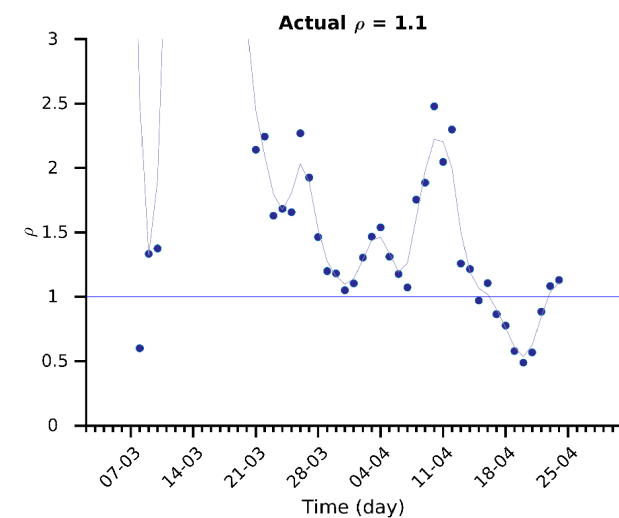
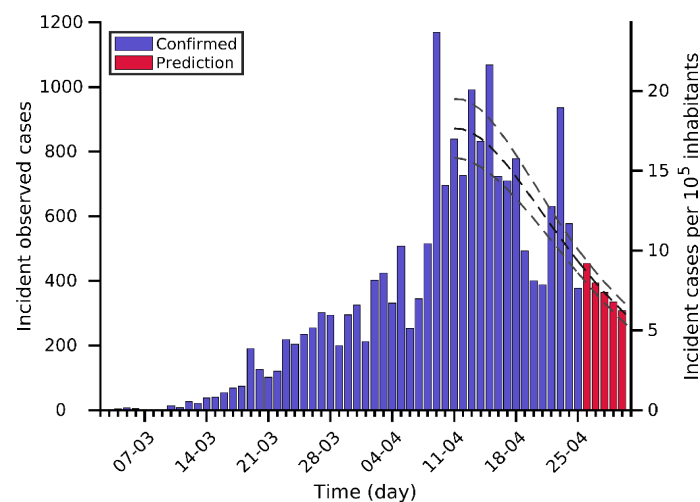
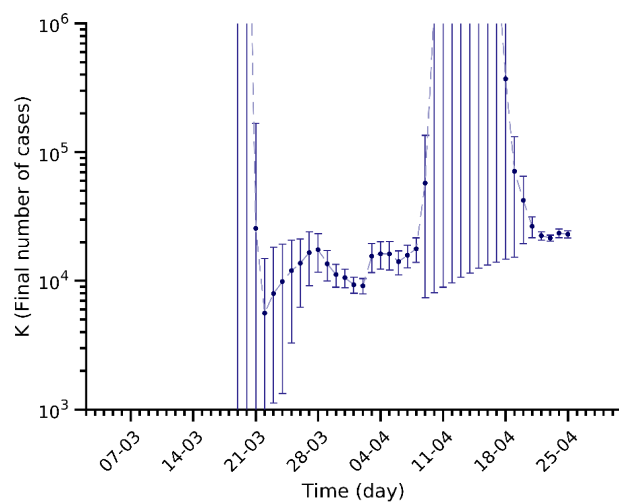
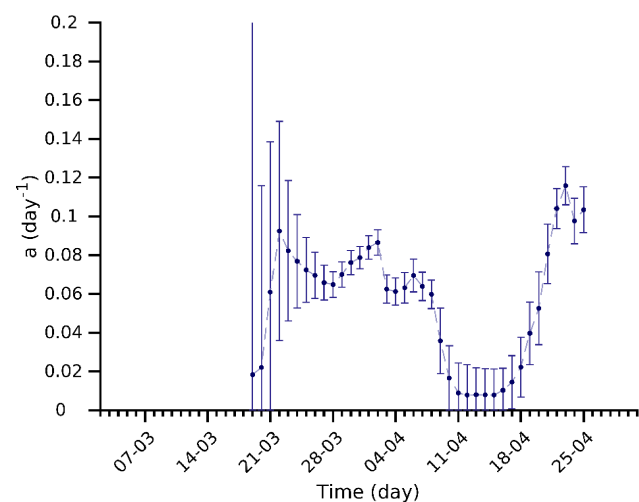
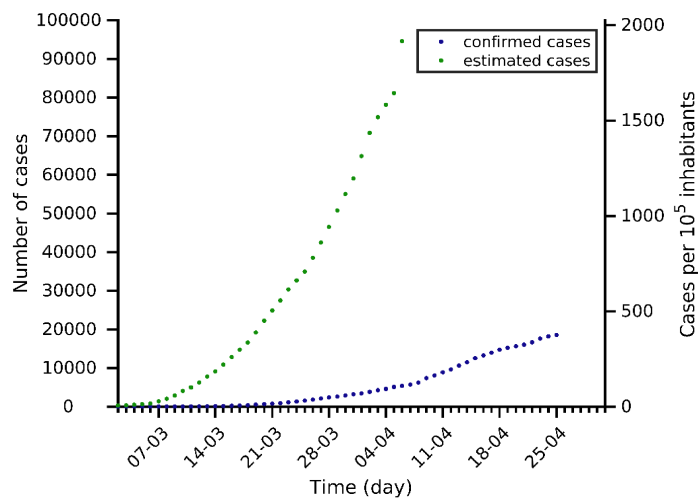
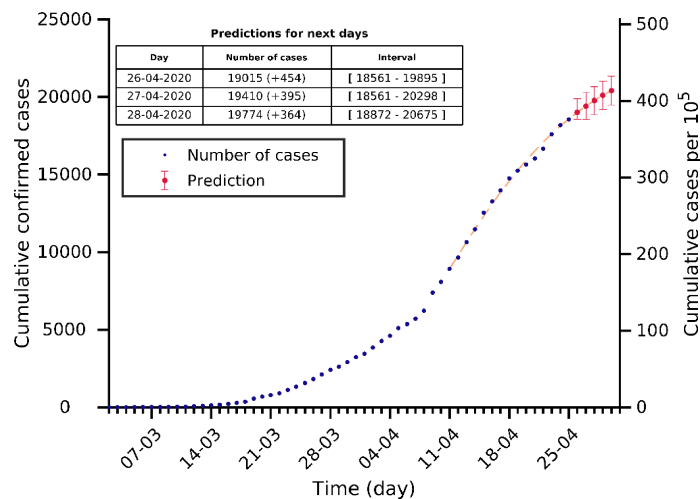
# Switzerland 25-04-2020. Population: 8.7M. Current cumulated incidence: 333/10<sup>5</sup>



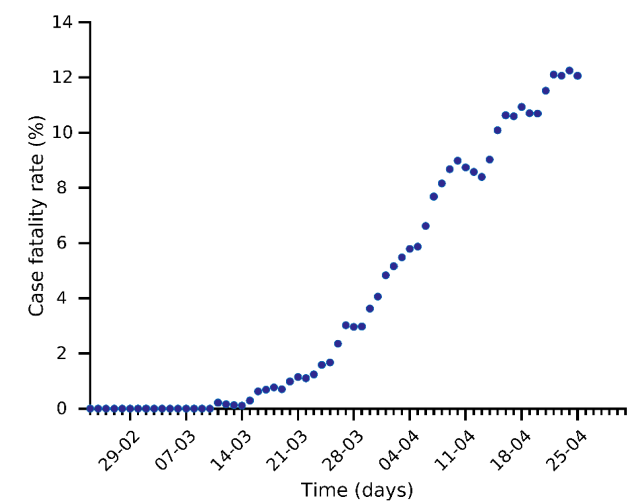
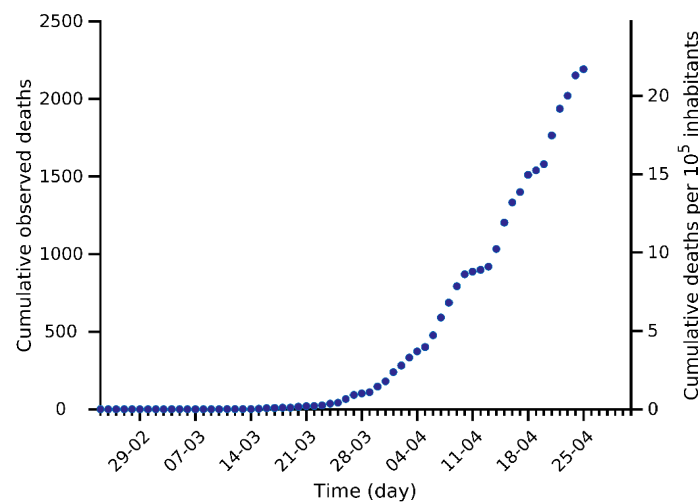
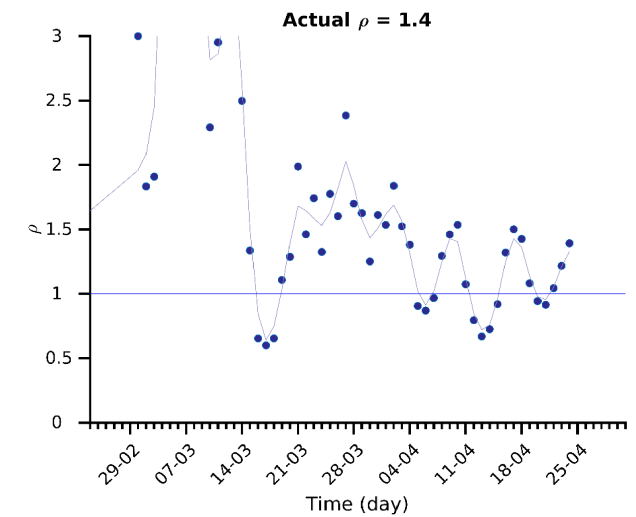
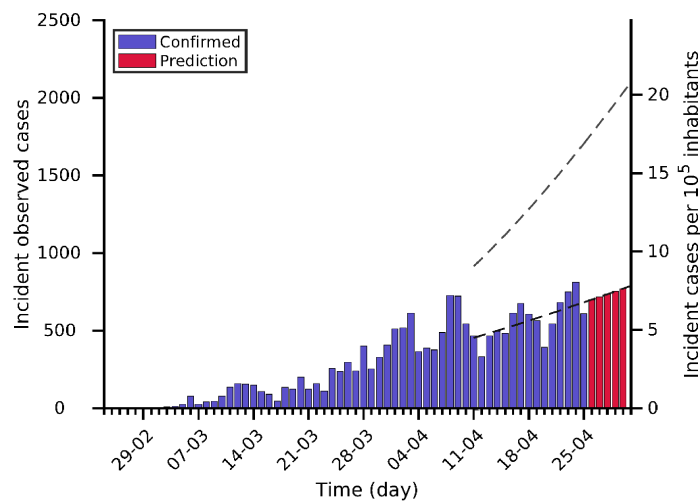
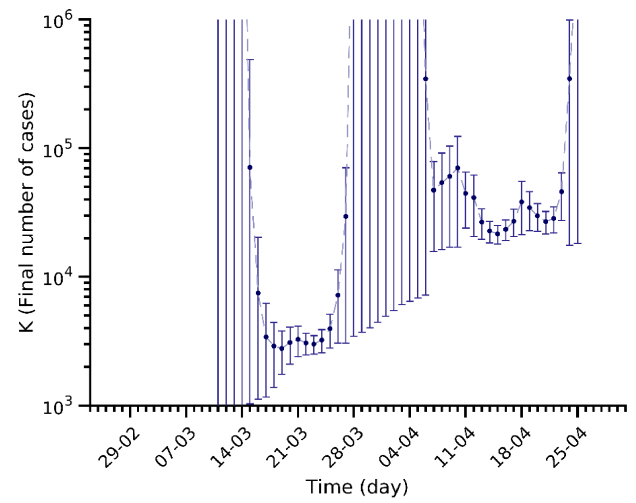
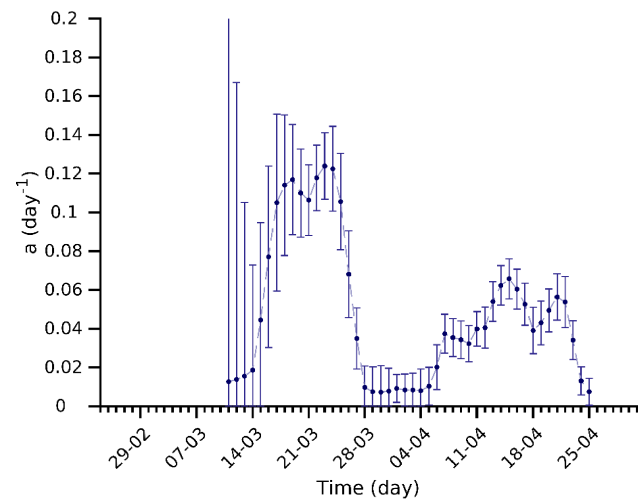
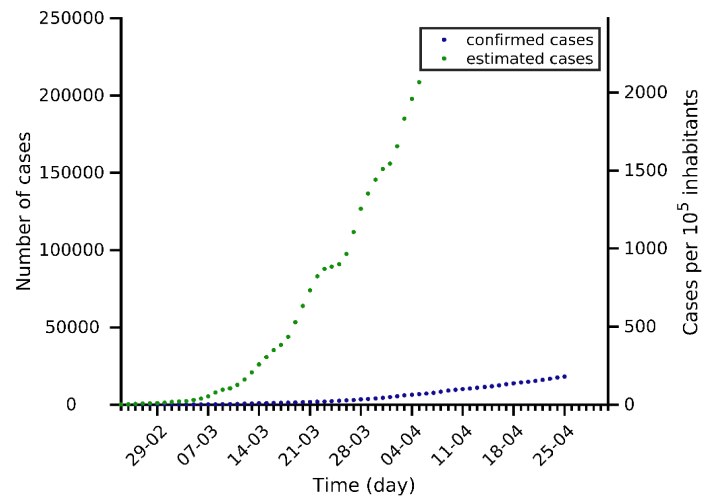
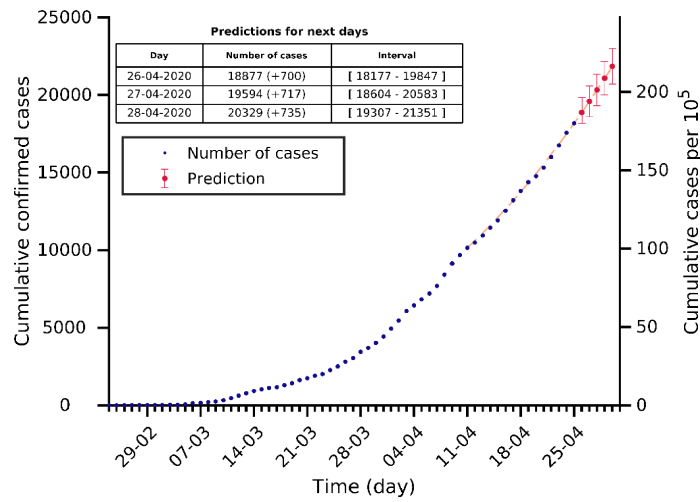
# Portugal 25-04-2020. Population: 10.2M. Current cumulated incidence: 229/10<sup>5</sup>



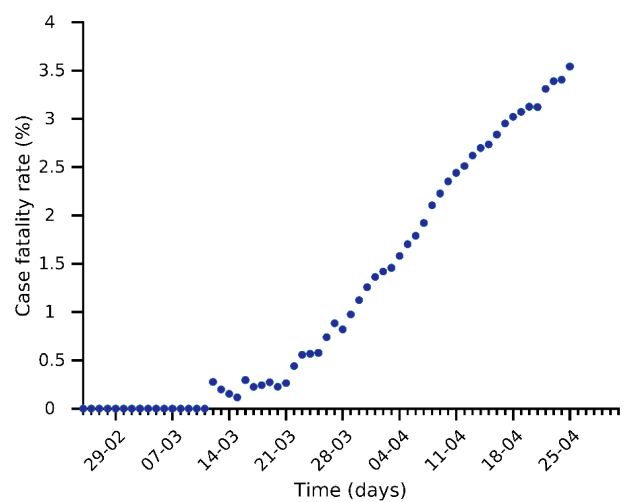
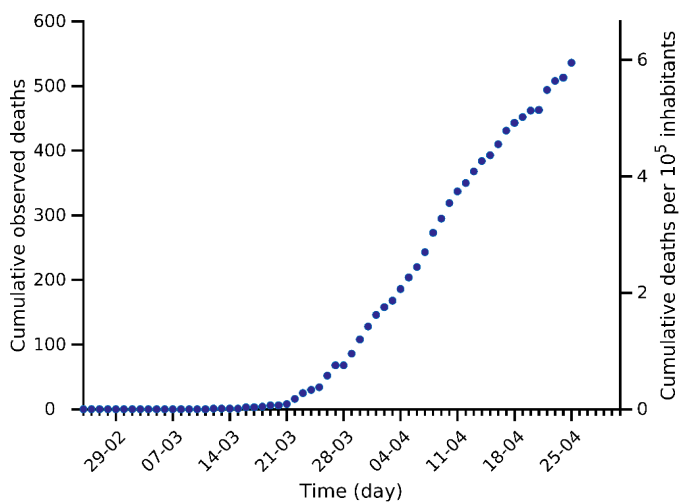
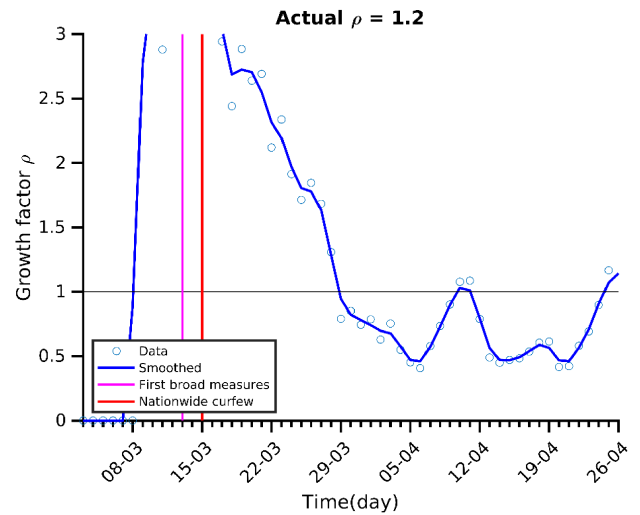
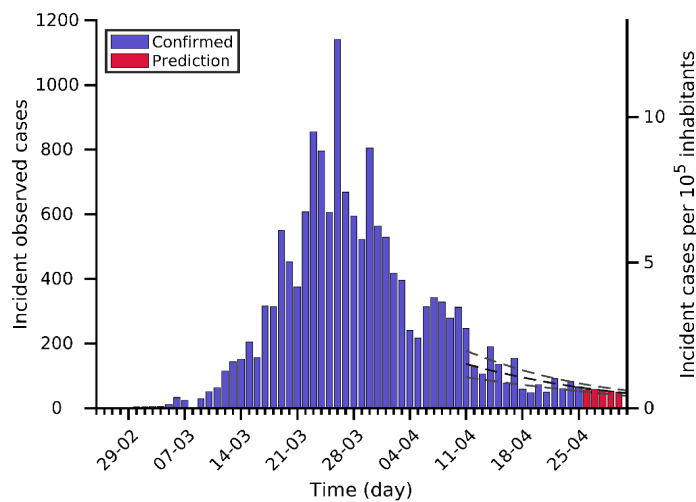
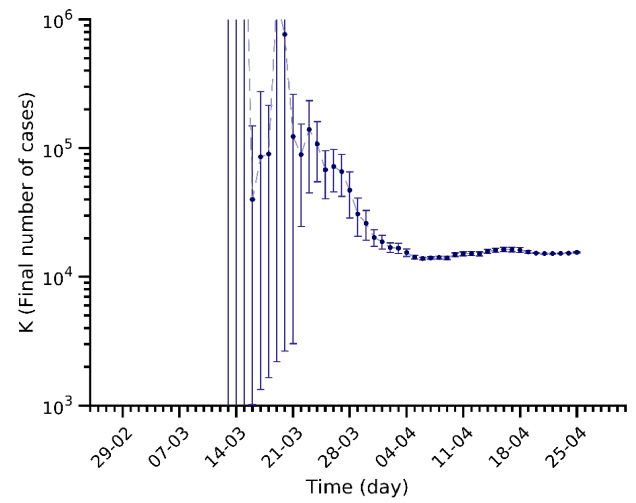
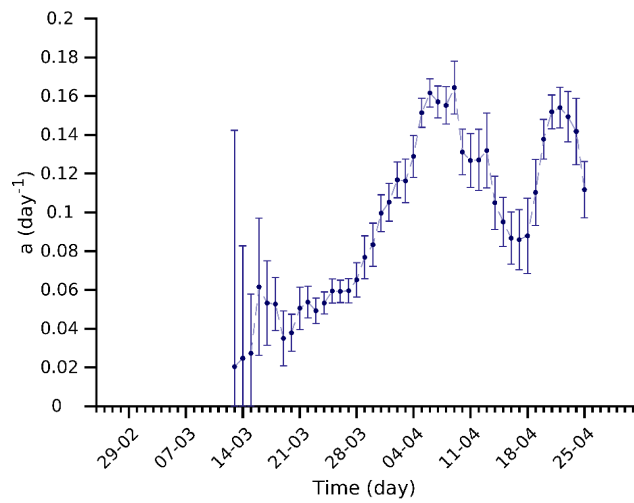
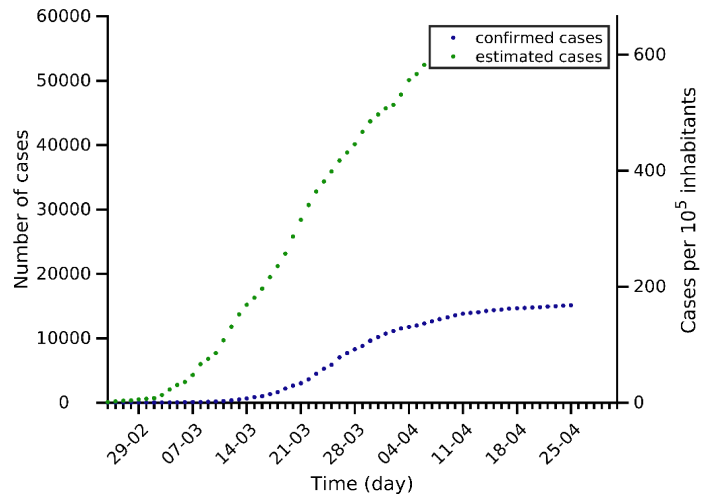
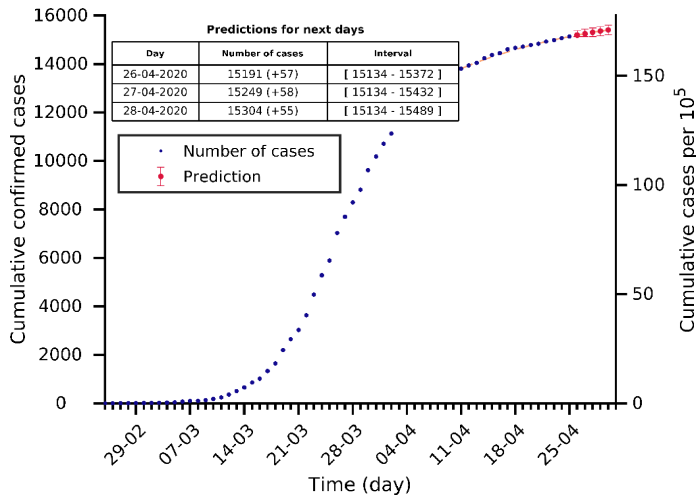
# Ireland 25-04-2020. Population: 4.9M. Current cumulated incidence: 376/10<sup>5</sup>



# Sweden 25-04-2020. Population: 10.1M. Current cumulated incidence: 180/10<sup>5</sup>

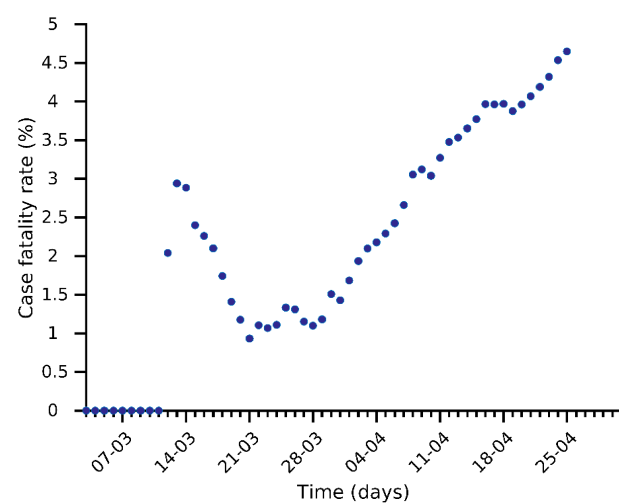
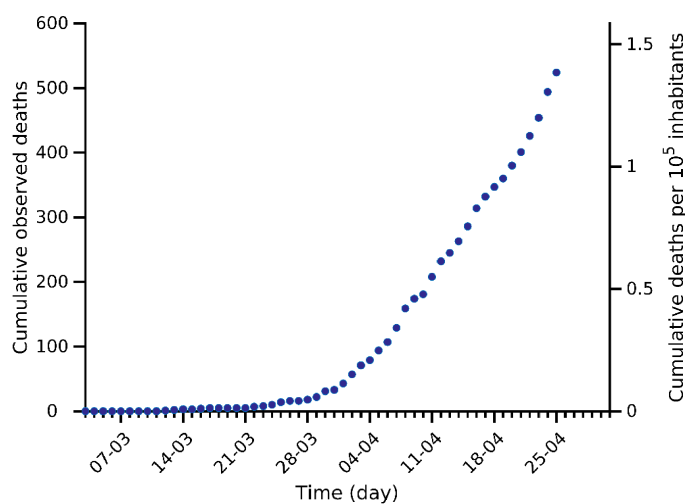
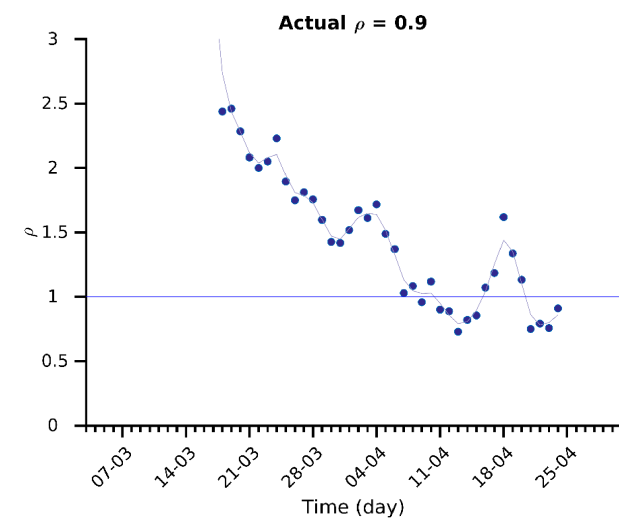
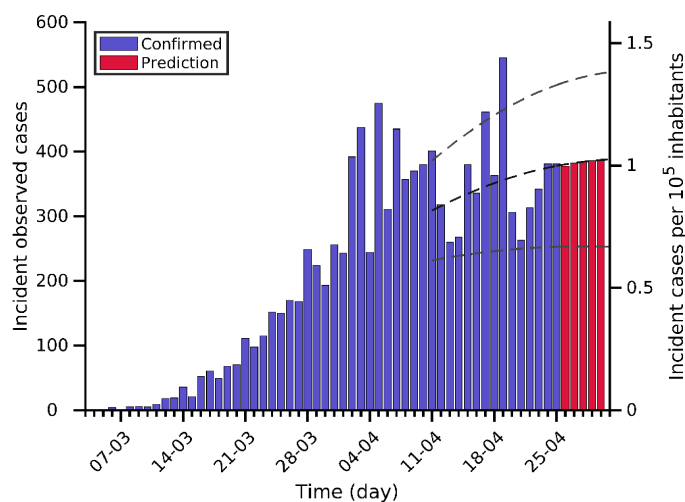
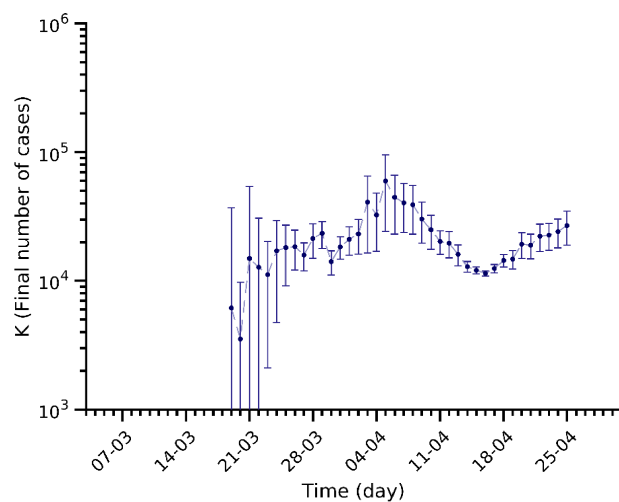
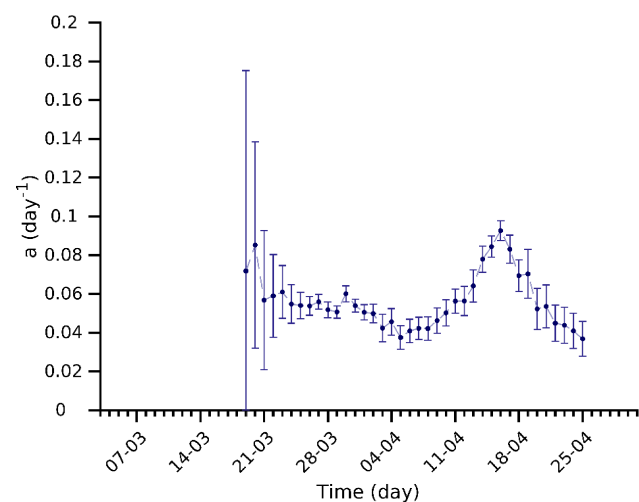
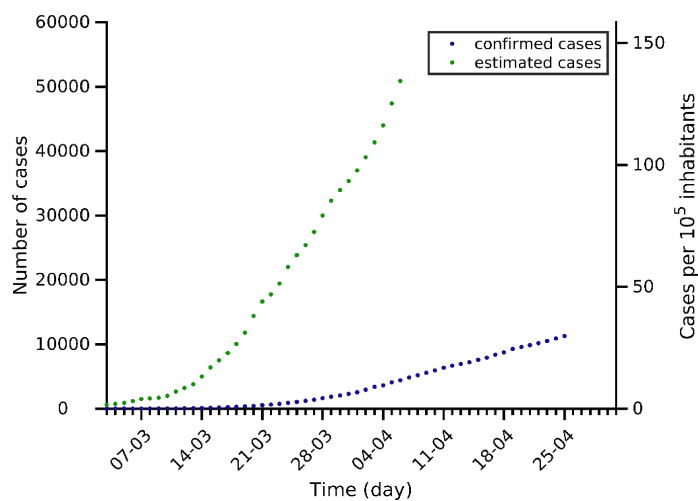
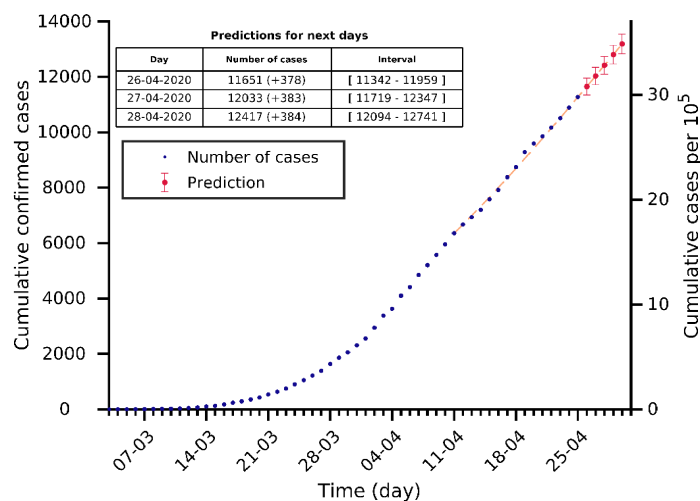


# Austria 25-04-2020. Population: 9.0M. Current cumulated incidence: 168/10<sup>5</sup>

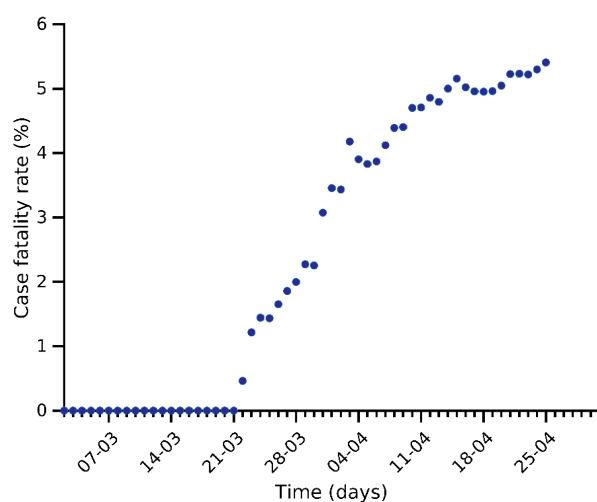
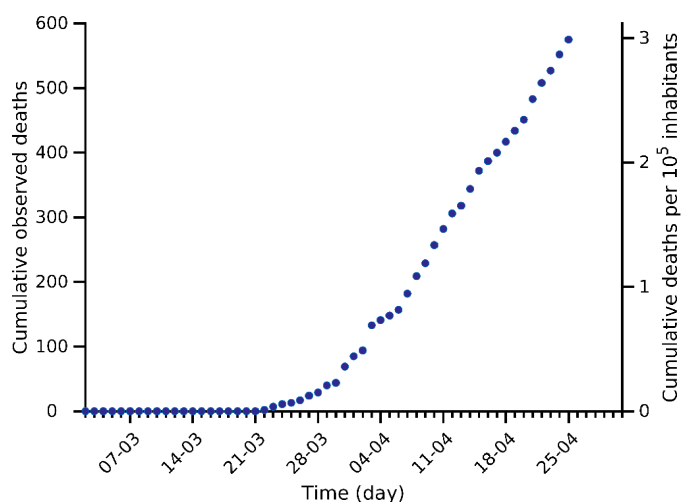
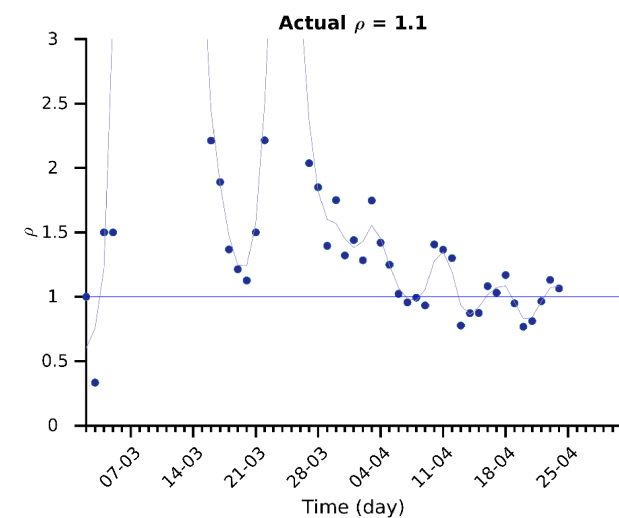
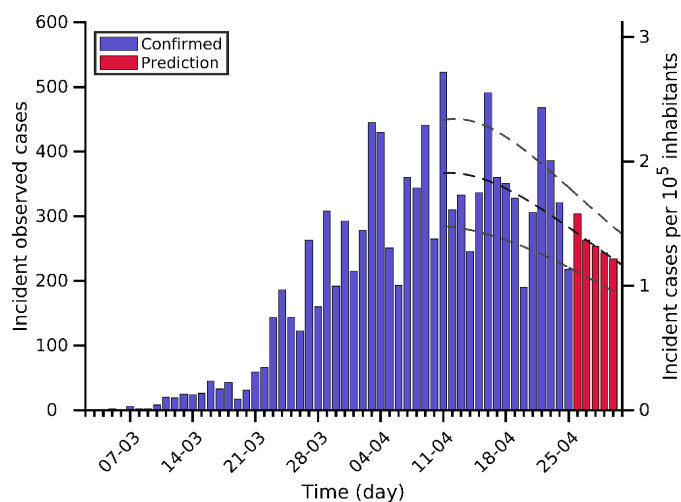
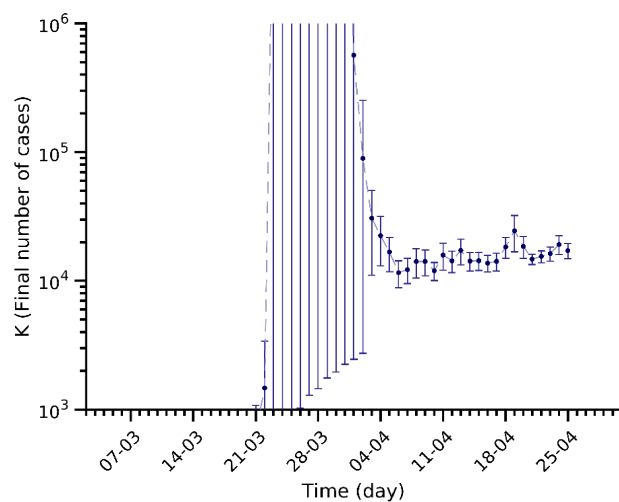
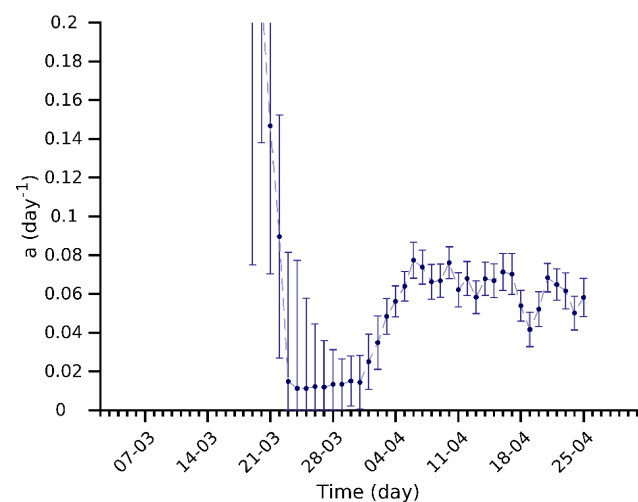
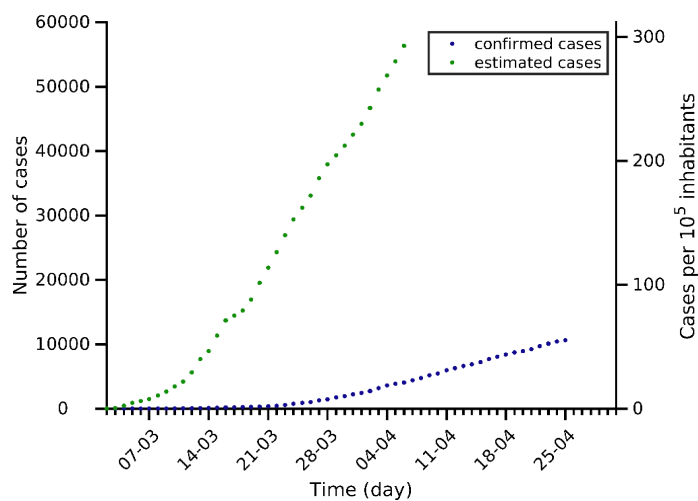
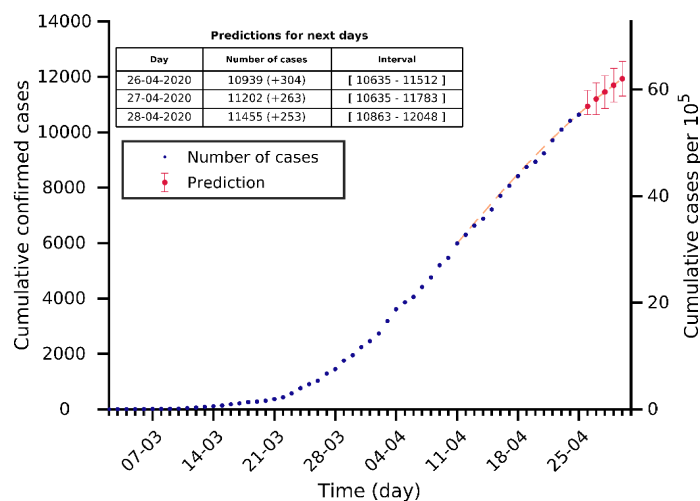




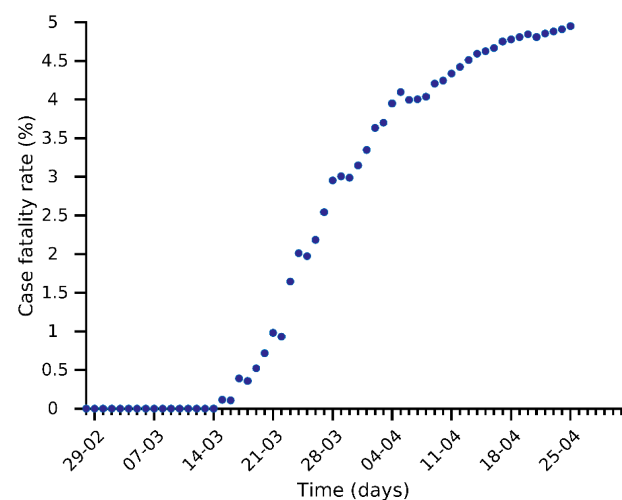
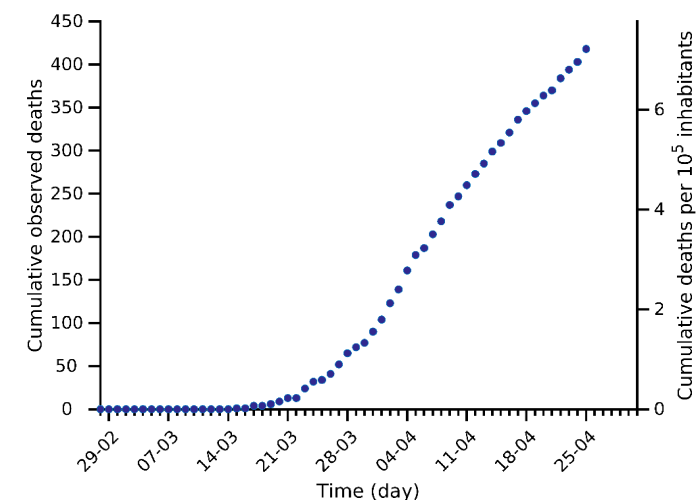
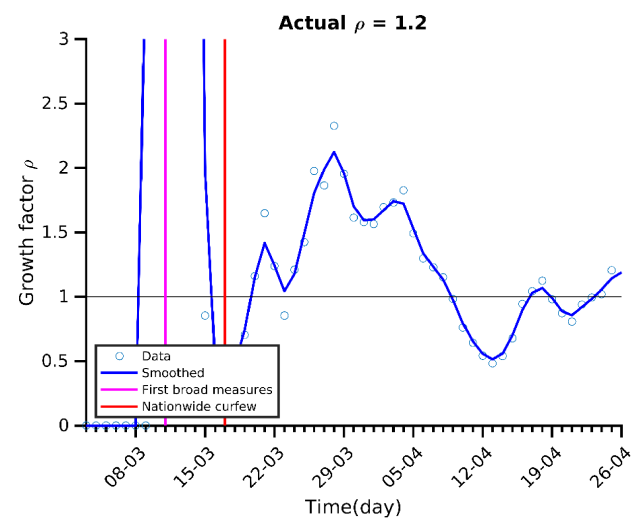
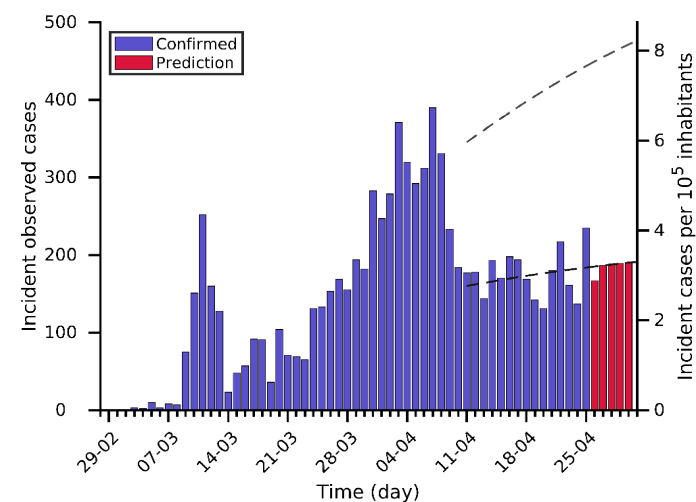
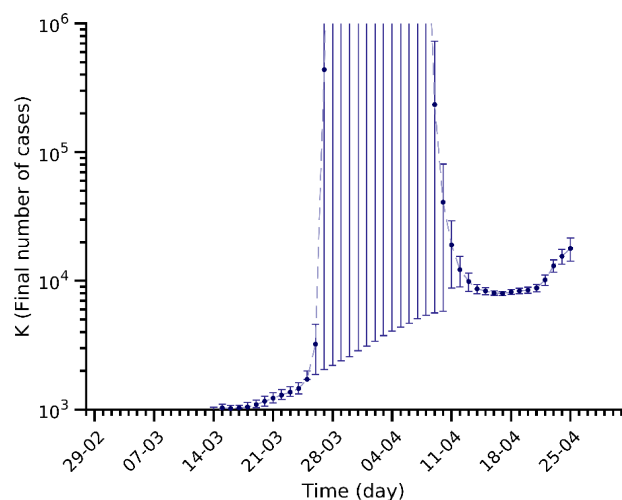
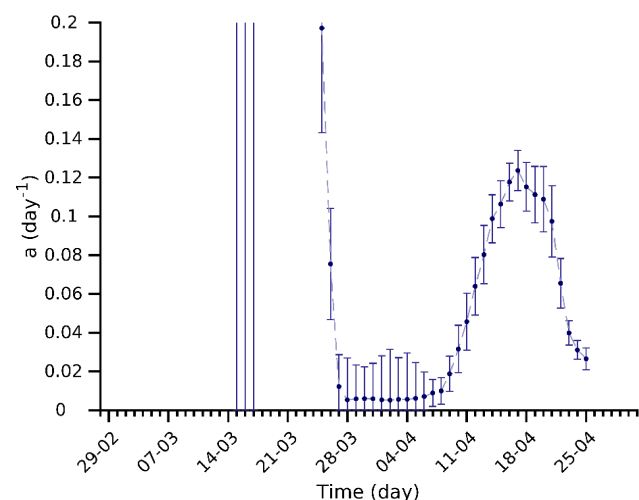
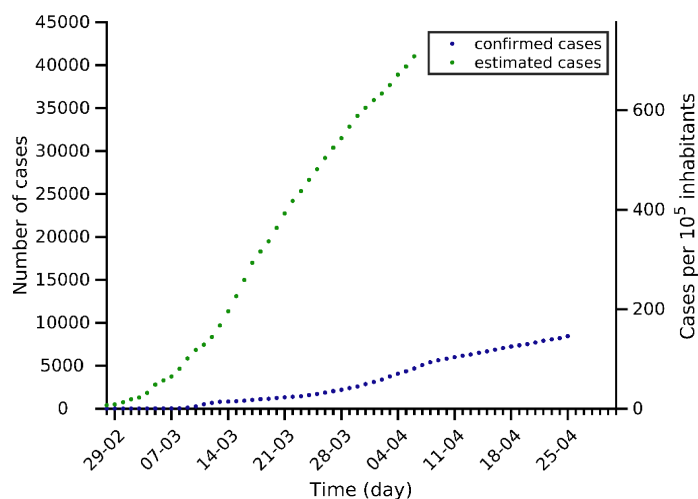
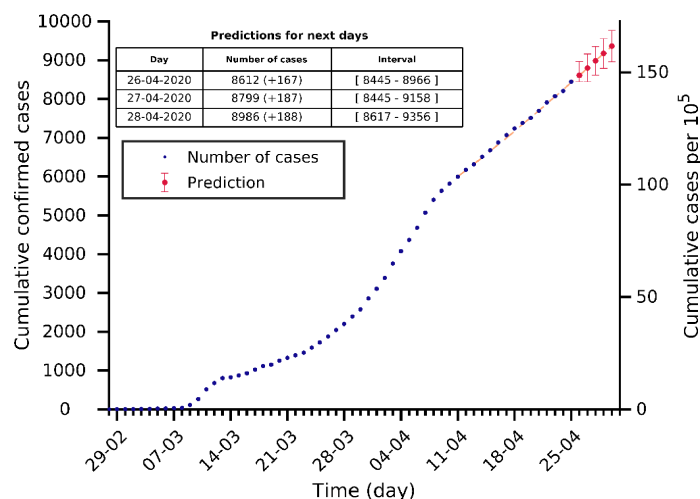
# Poland 25-04-2020. Population: 37.8M. Current cumulated incidence: 30/10<sup>5</sup>



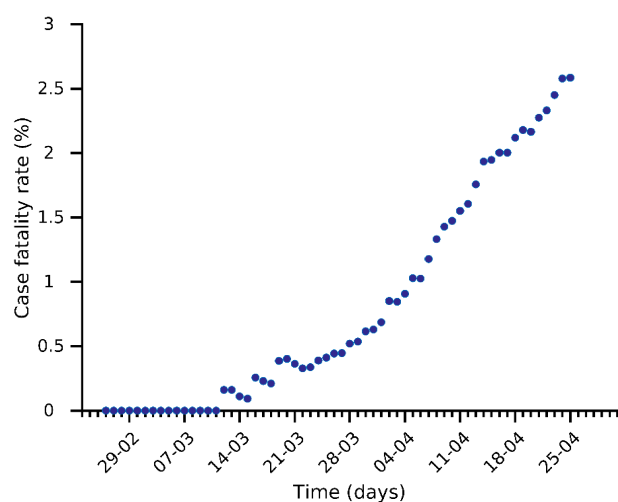
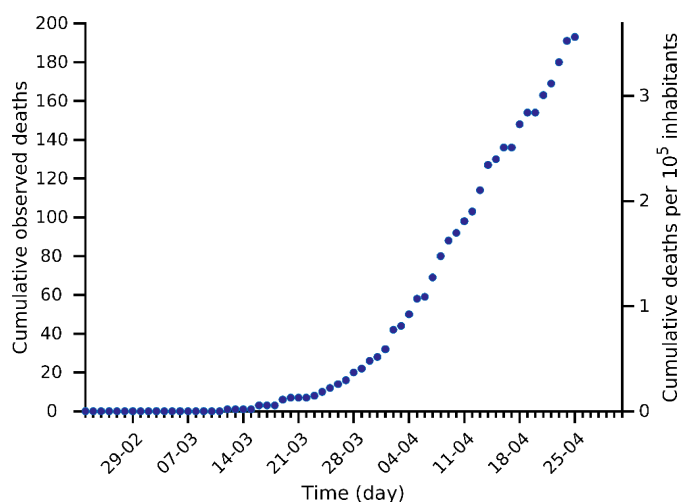
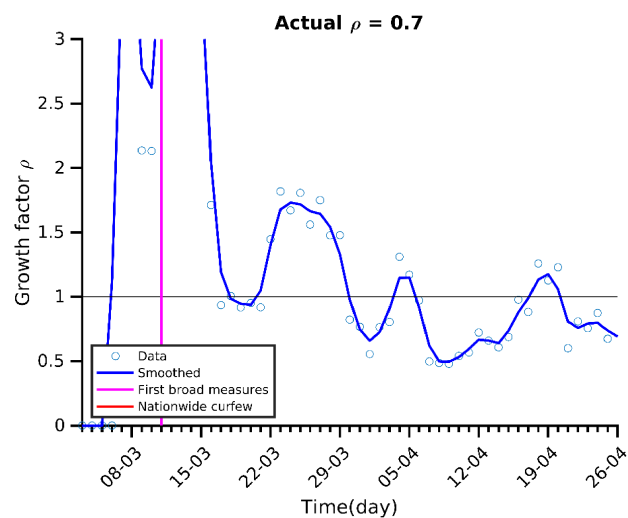
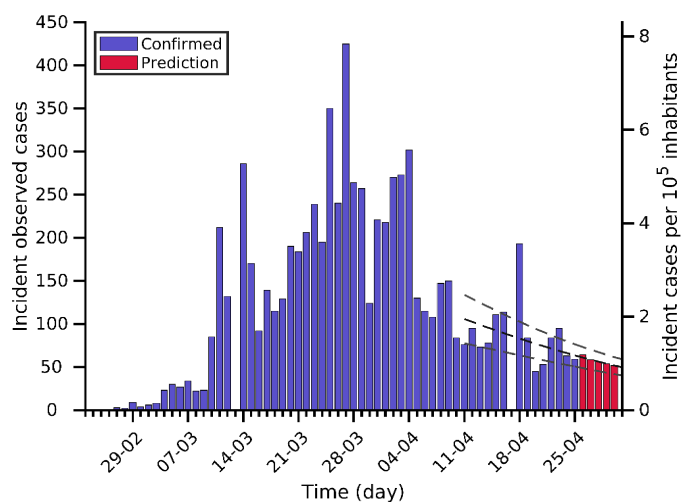
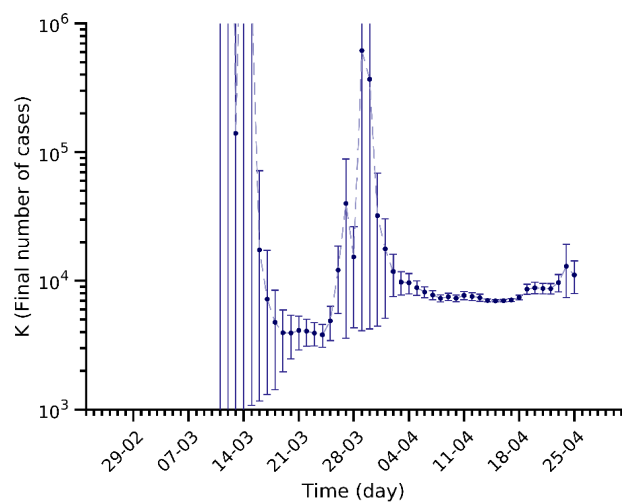
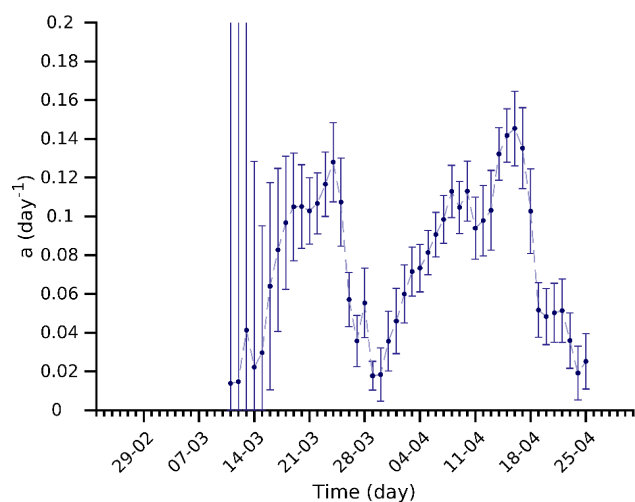
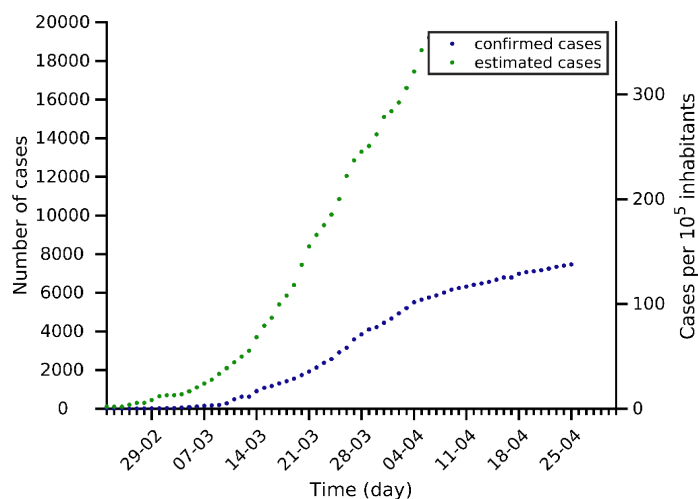
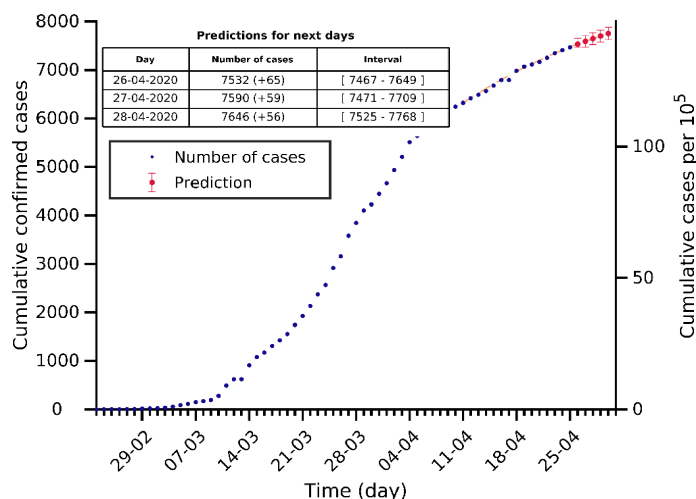
# Romania 25-04-2020. Population: 19.2M. Current cumulated incidence: 55/10<sup>5</sup>



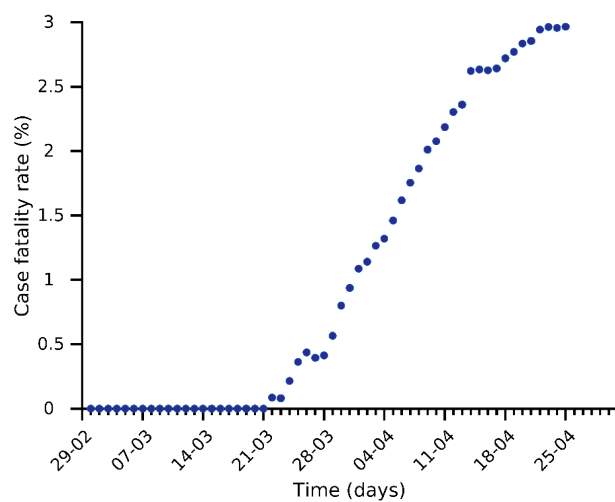
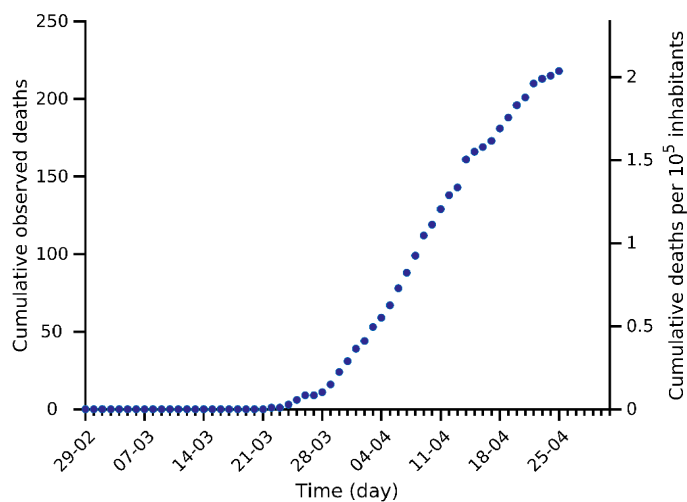
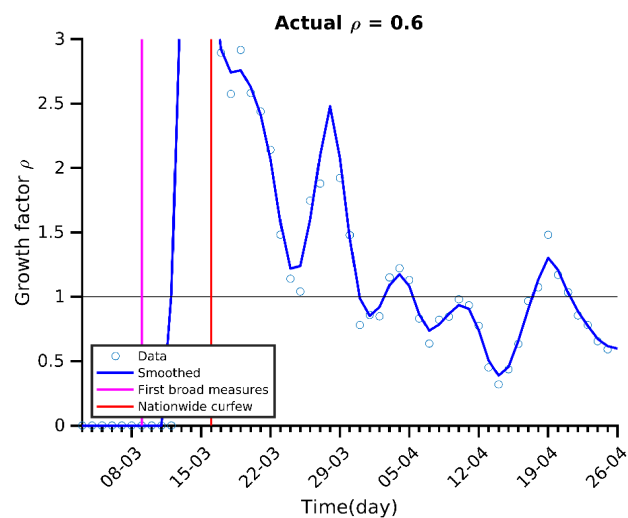
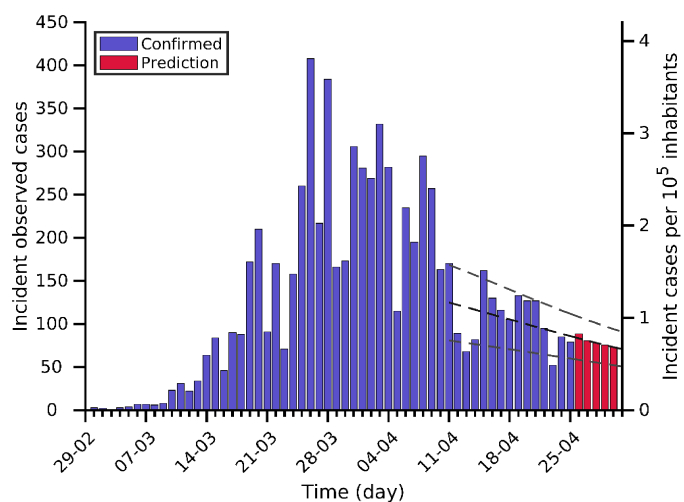
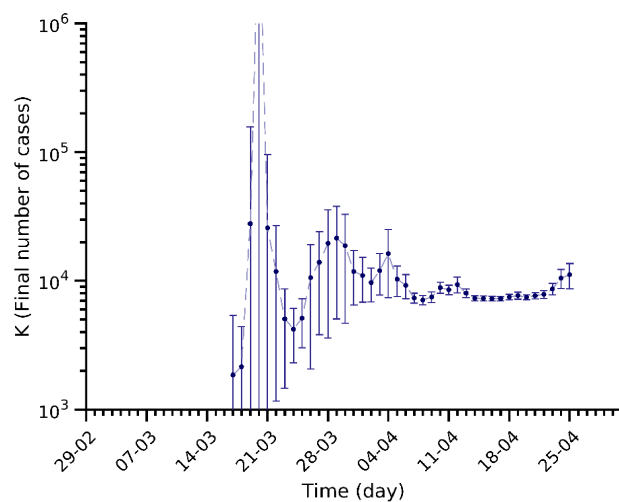
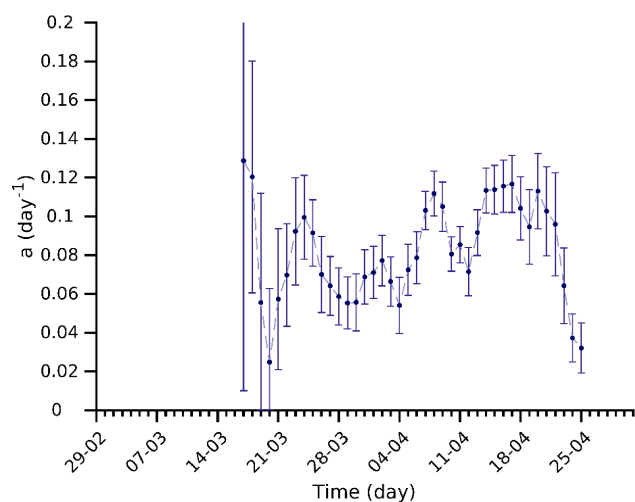
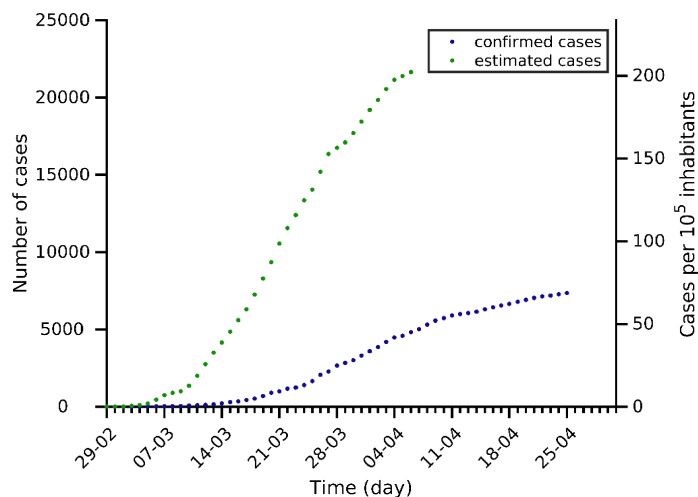
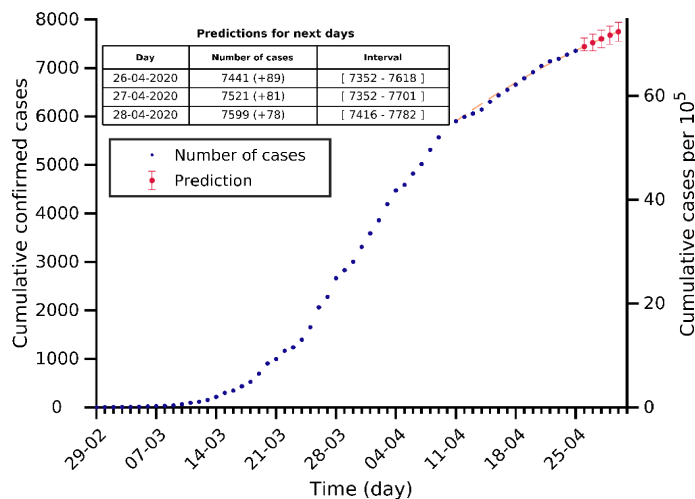
# Denmark 25-04-2020. Population: 5.8M. Current cumulated incidence: 146/10<sup>5</sup>



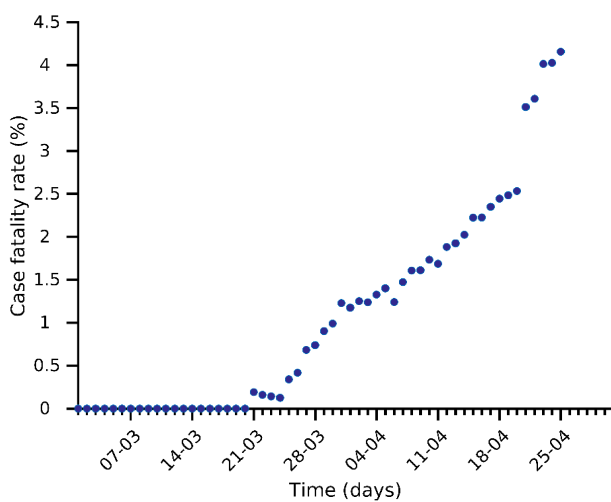
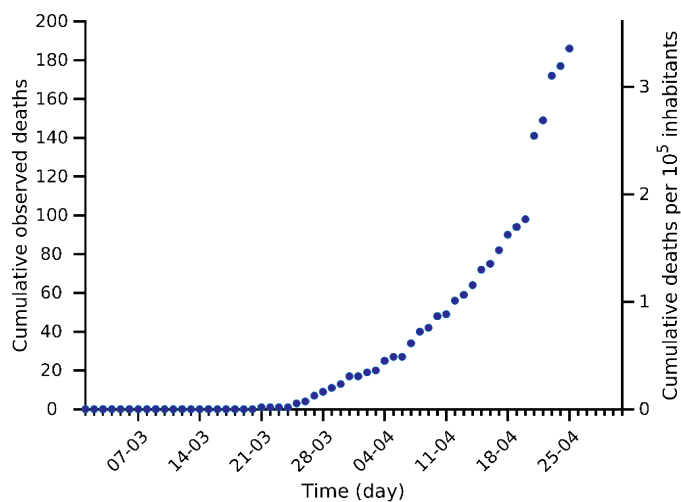
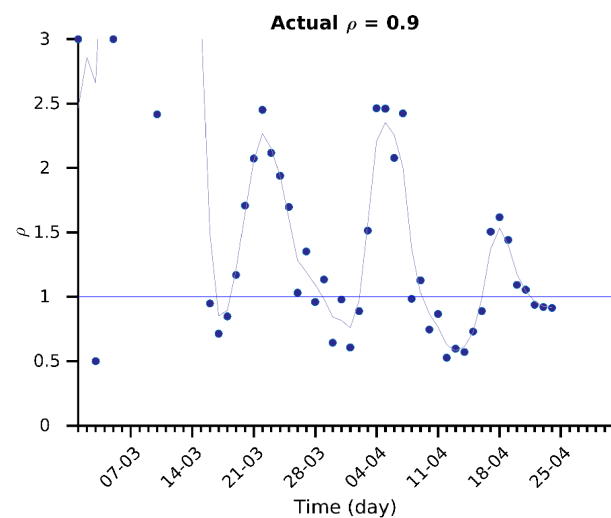
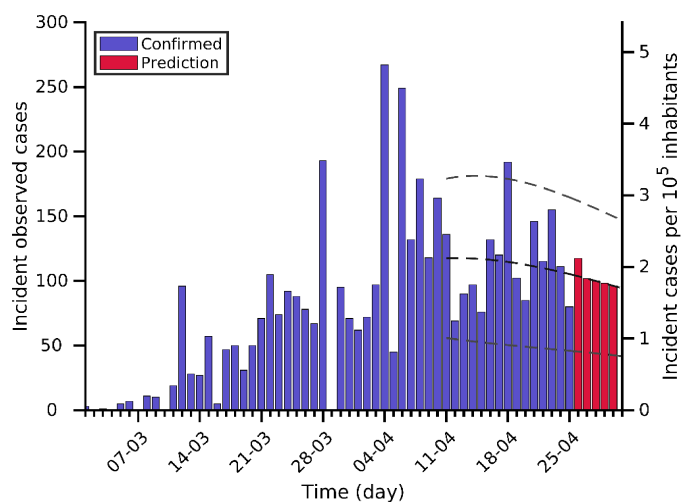
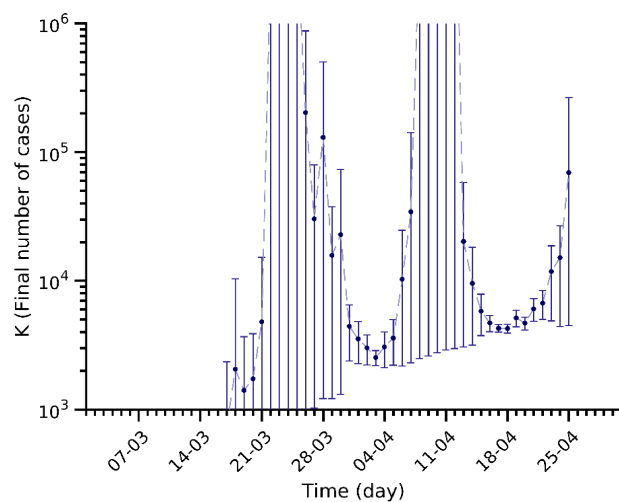
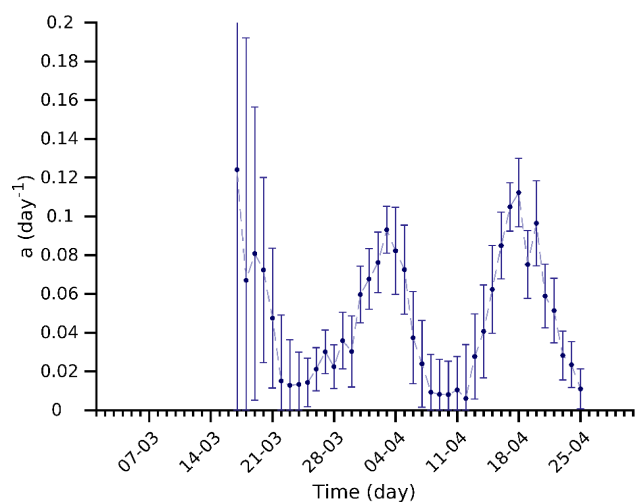
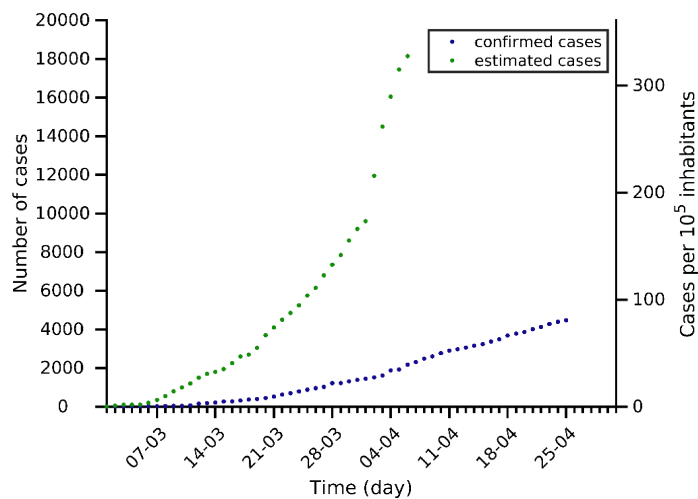
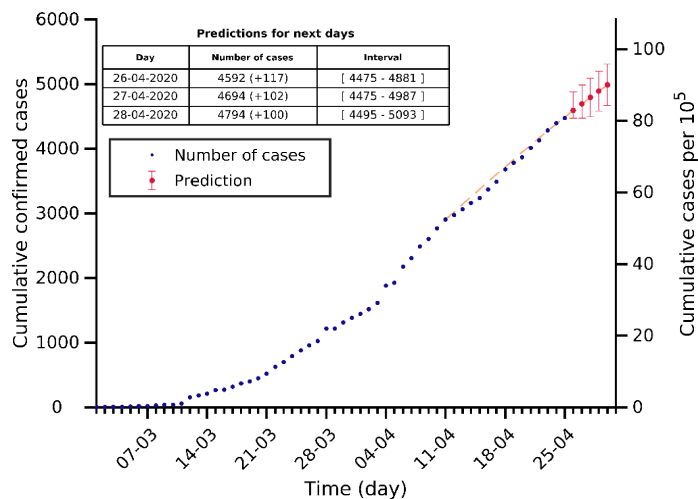
# Norway 25-04-2020. Population: 5.4M. Current cumulated incidence: 138/10<sup>5</sup>



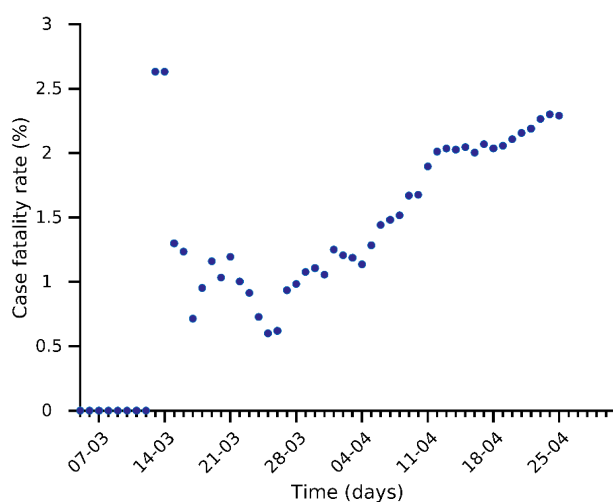
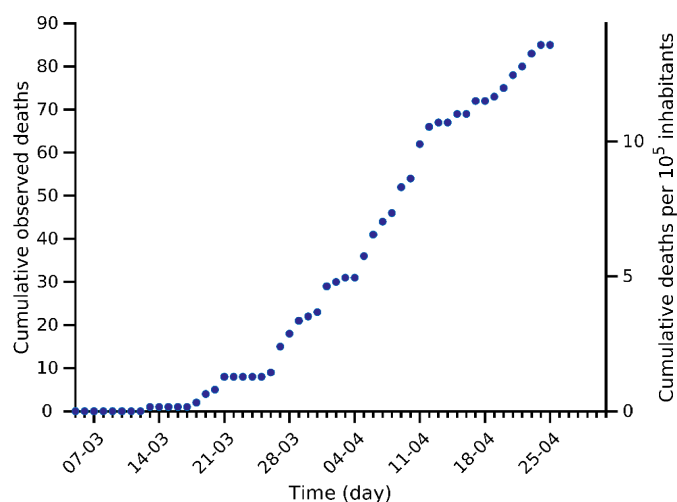
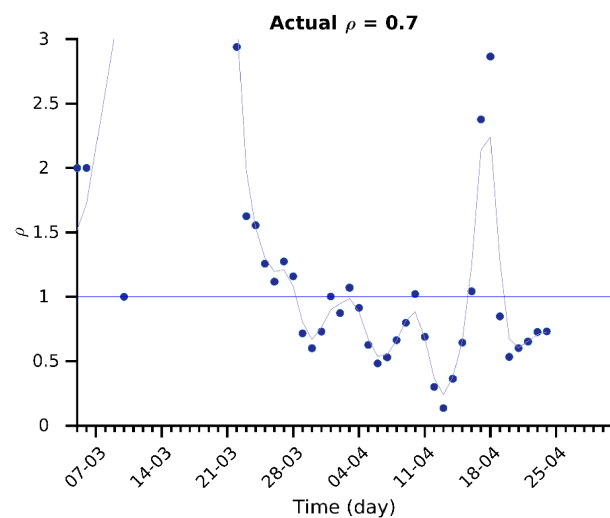
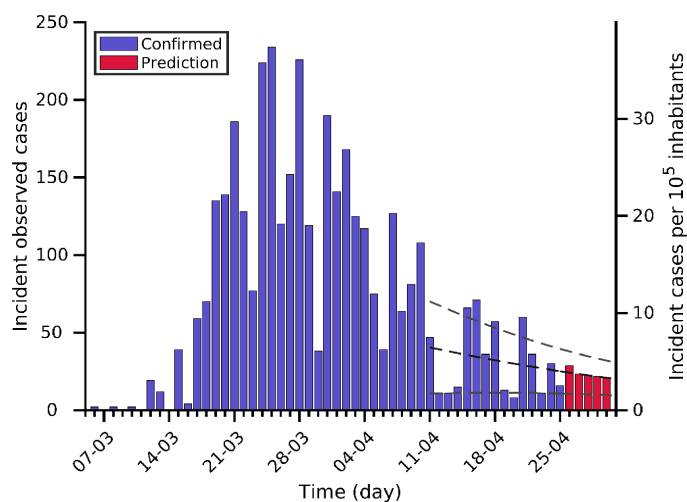
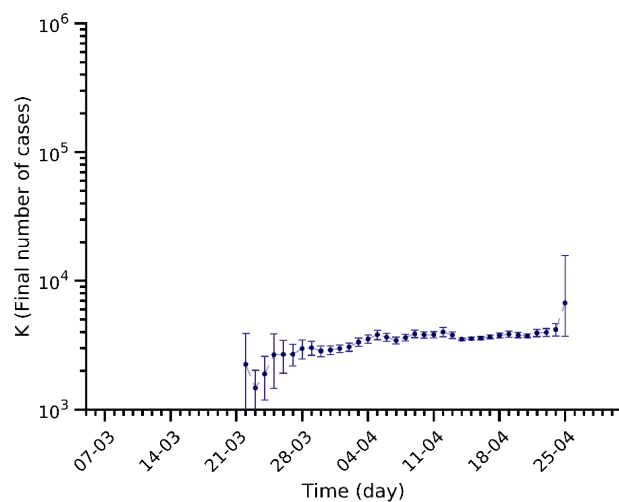
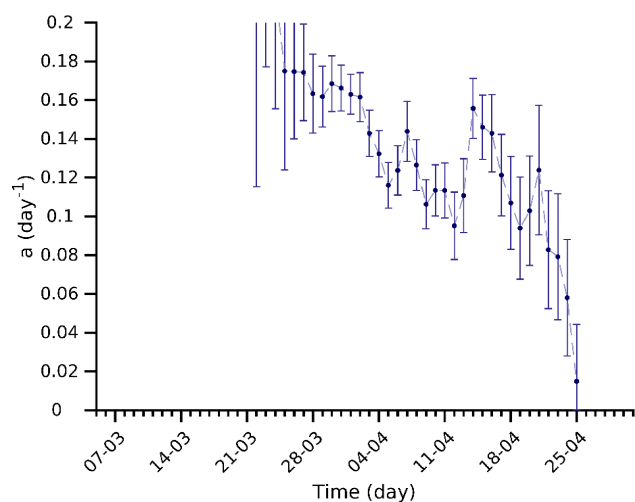
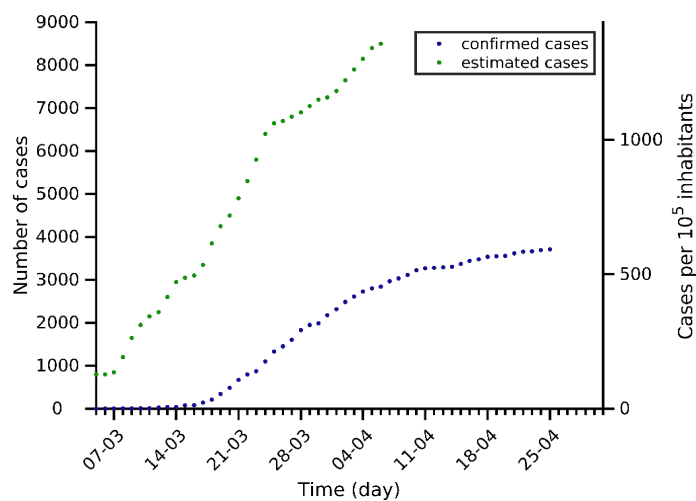
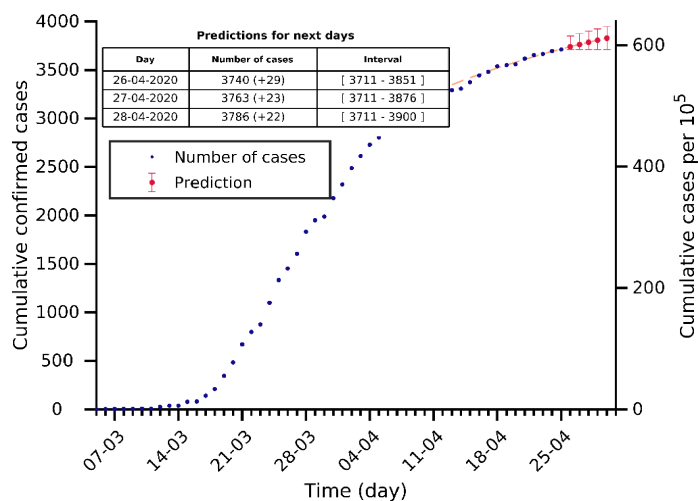
# Czech Rep 25-04-2020. Population: 10.7M. Current cumulated incidence: 69/10<sup>5</sup>



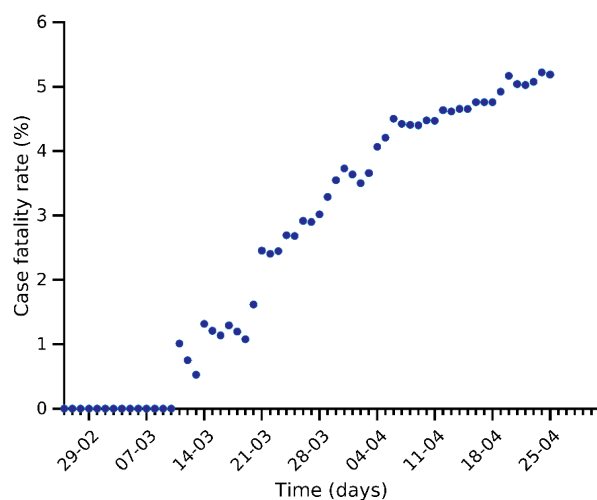
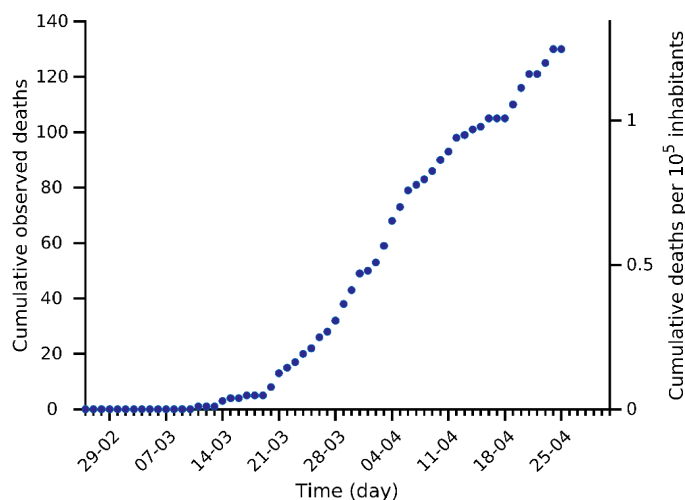
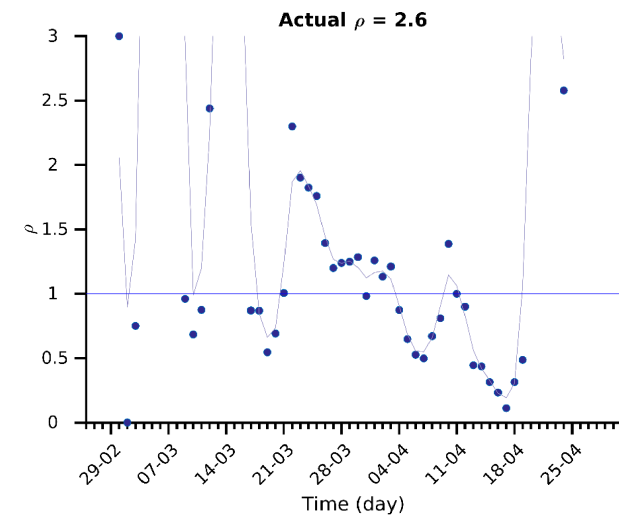
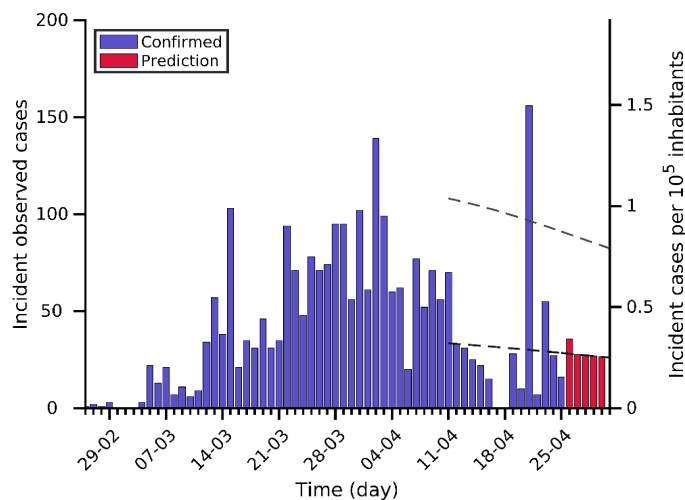
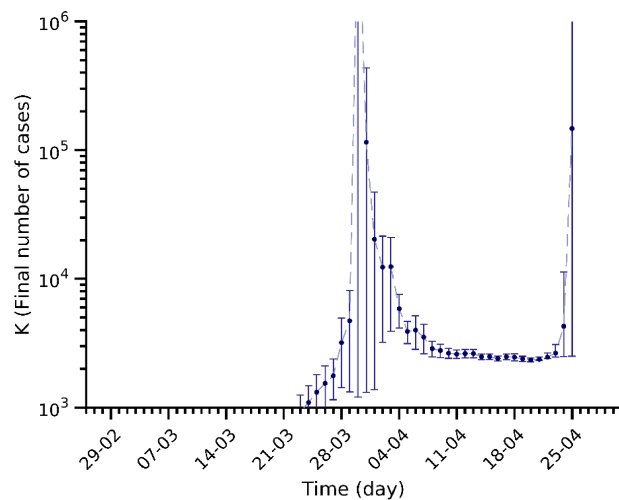
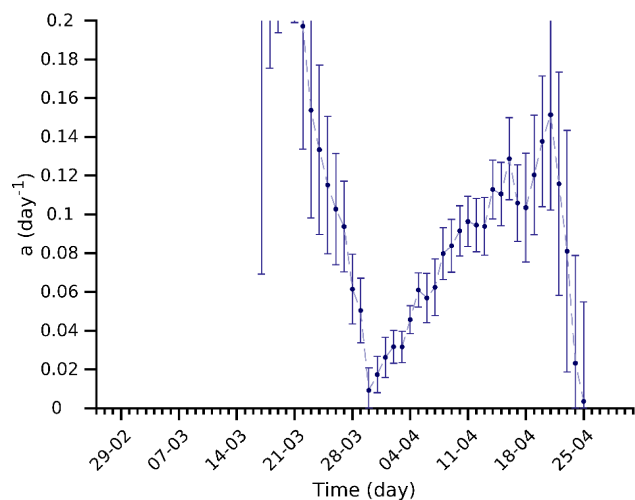
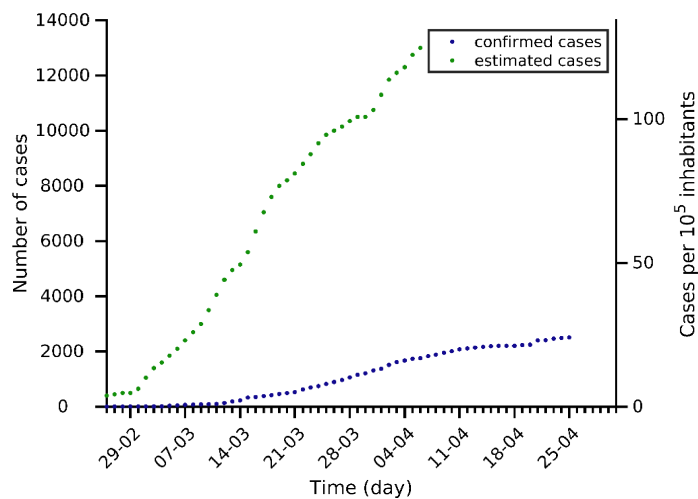
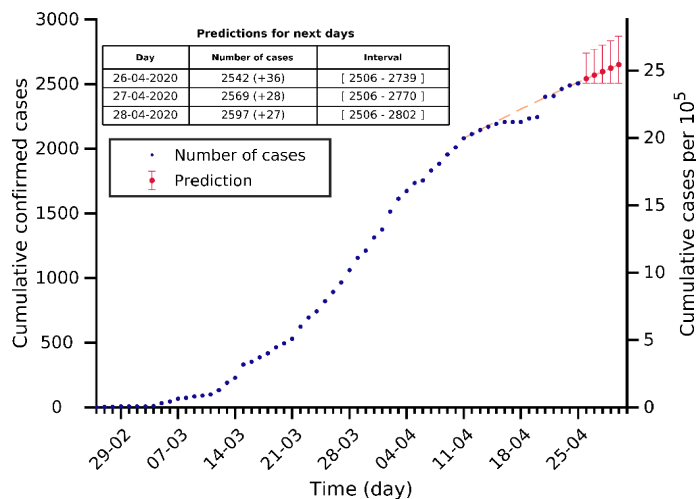
# Finland 25-04-2020. Population: 5.5M. Current cumulated incidence: 81/10<sup>5</sup>



# Luxembourg 25-04-2020. Population: 0.6M. Current cumulated incidence: 593/10<sup>5</sup>

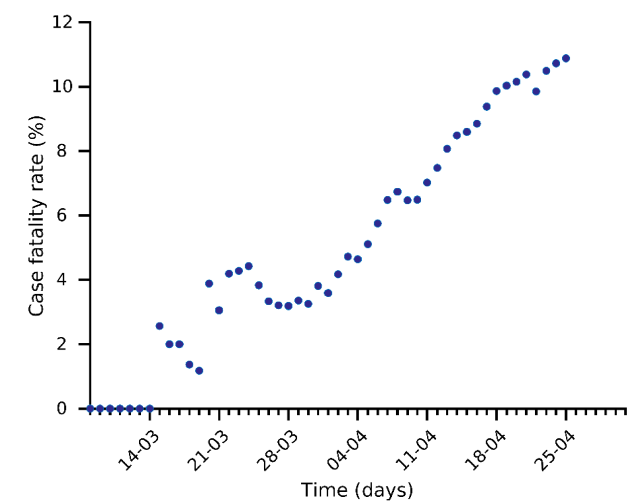
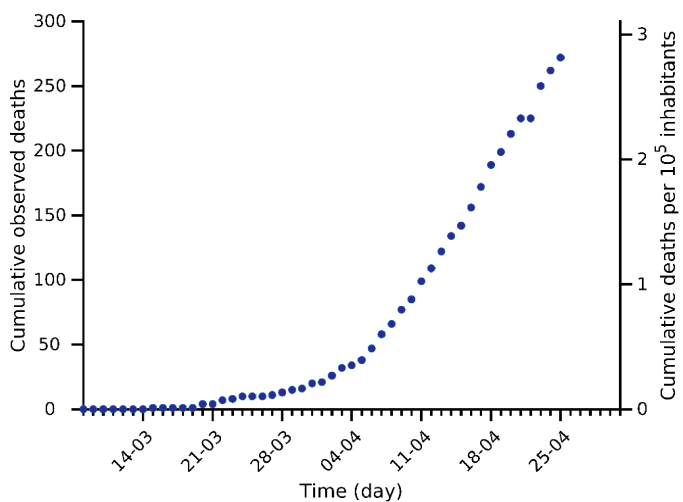
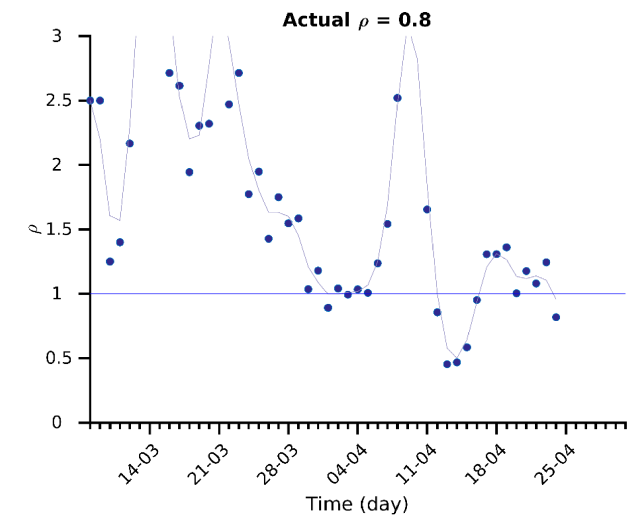
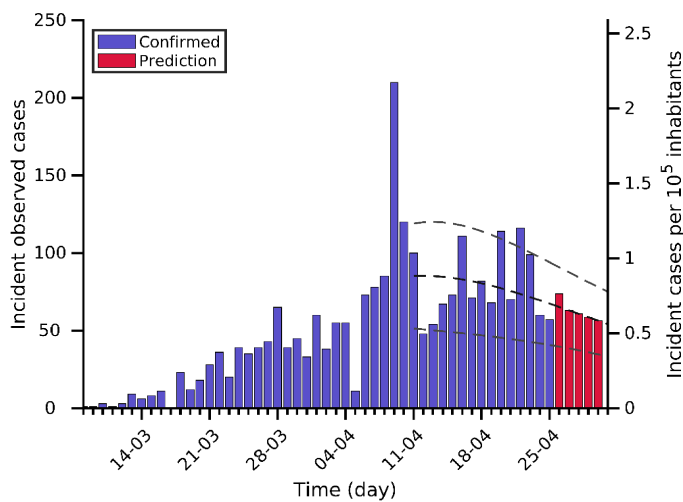
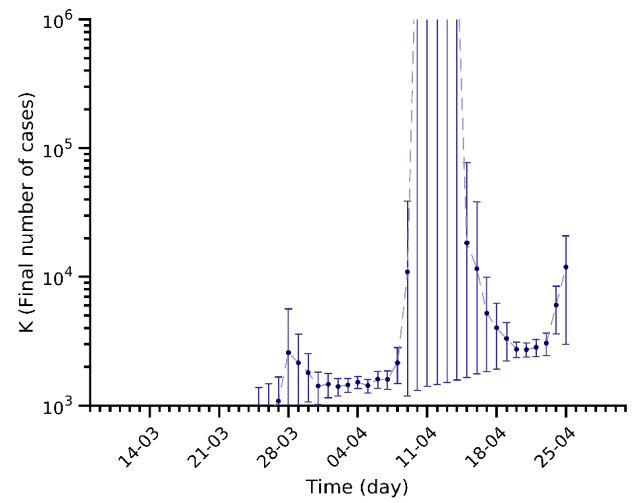
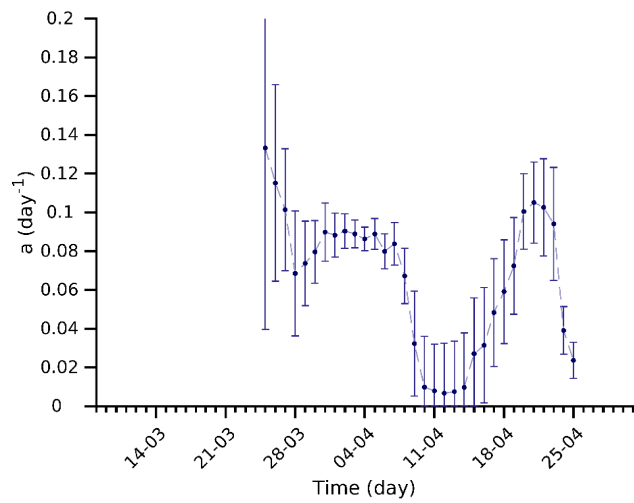
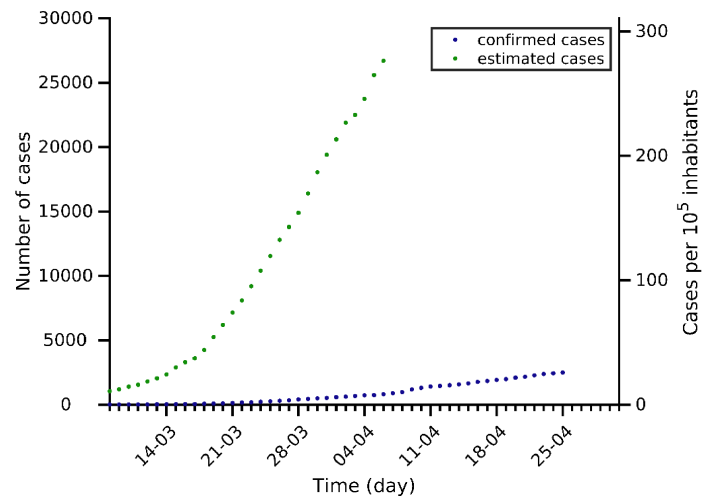
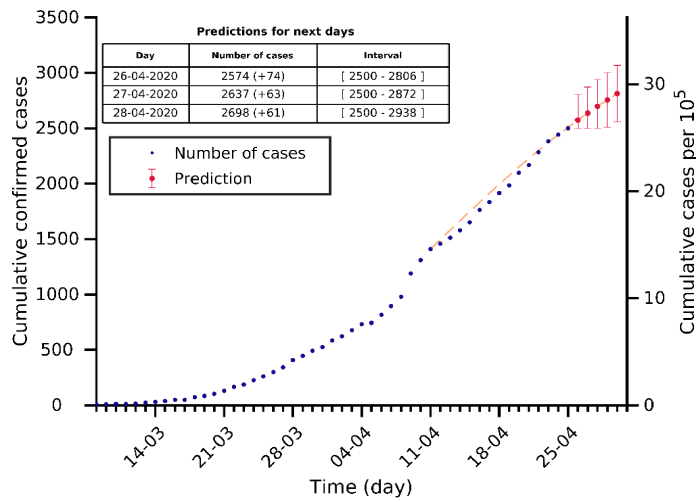


# Greece 25-04-2020. Population: 10.4M. Current cumulated incidence: 24/10<sup>5</sup>

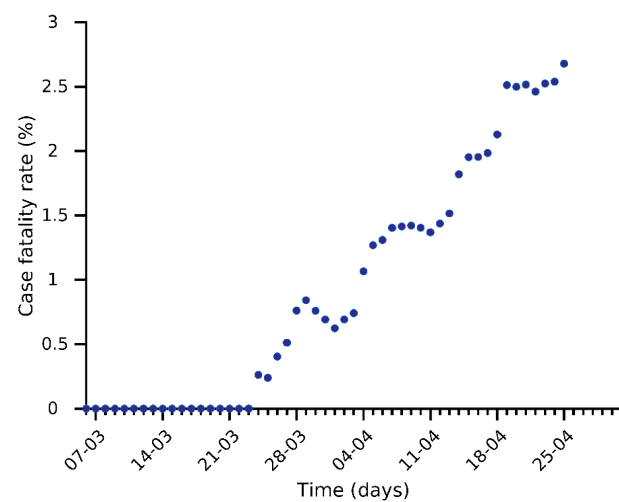
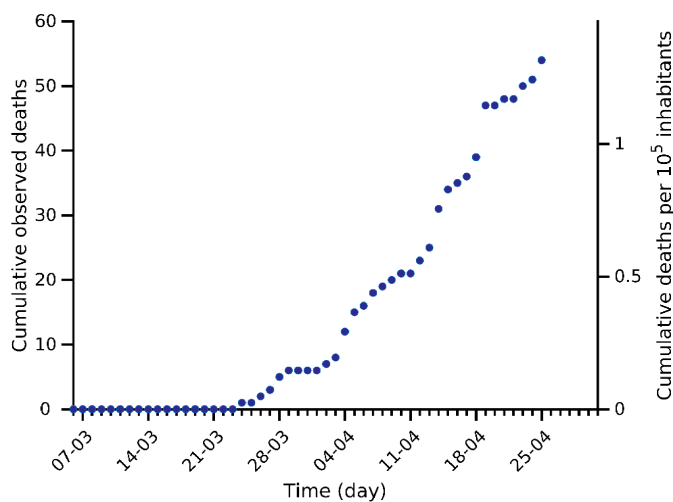
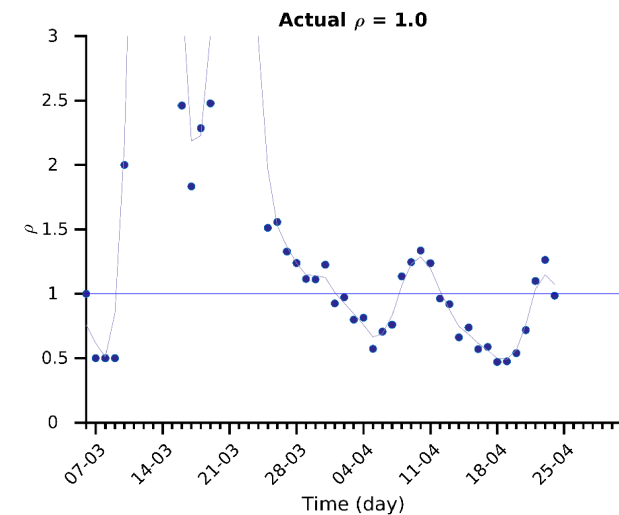
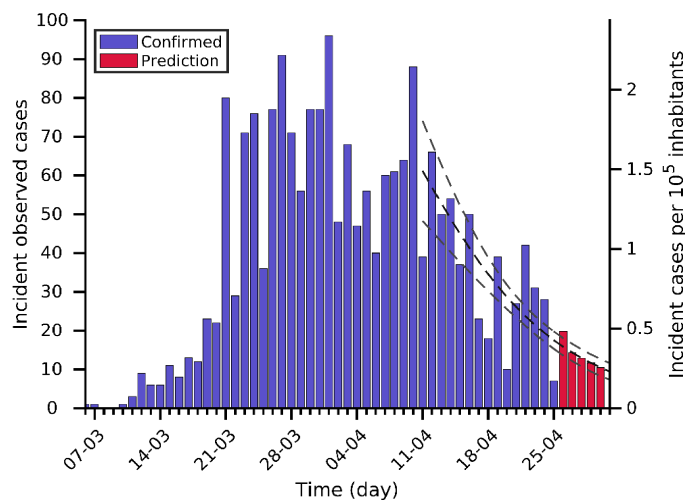
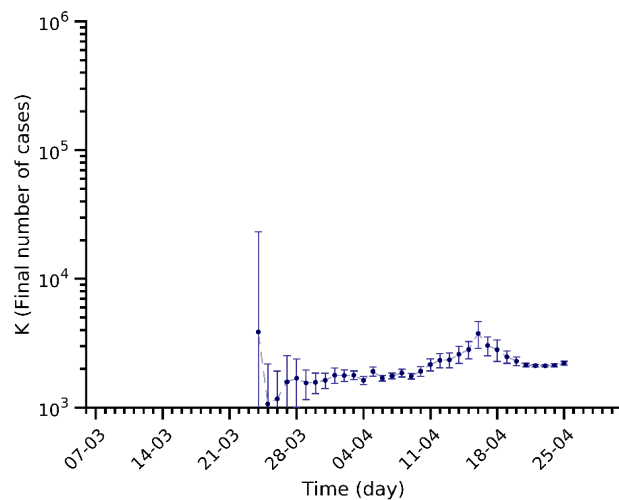
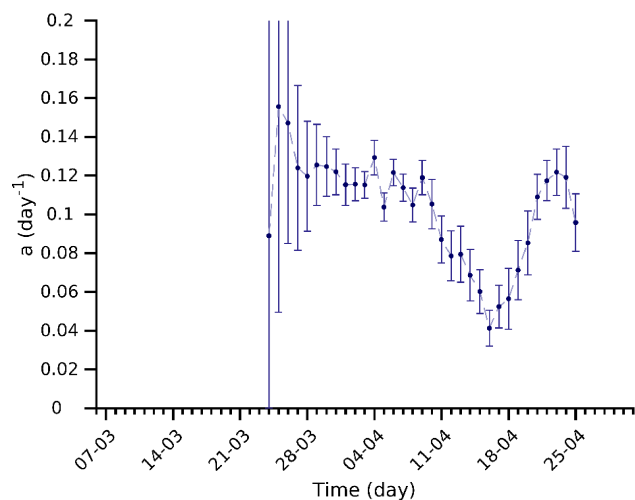
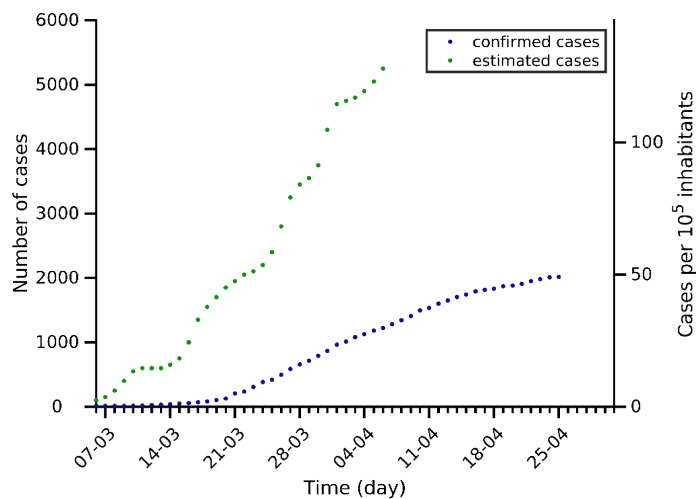
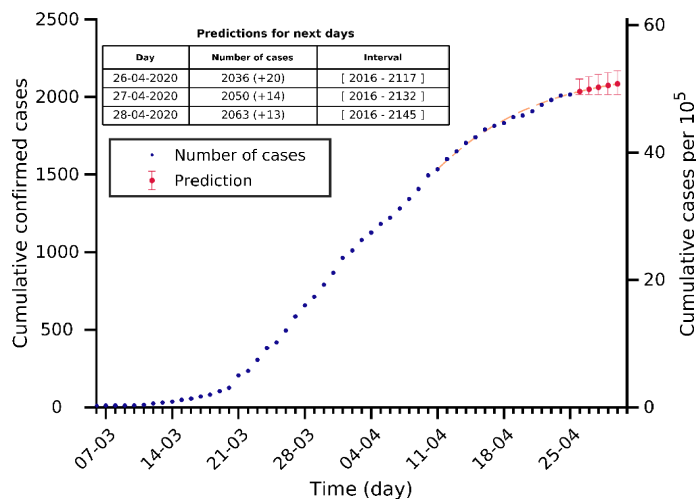




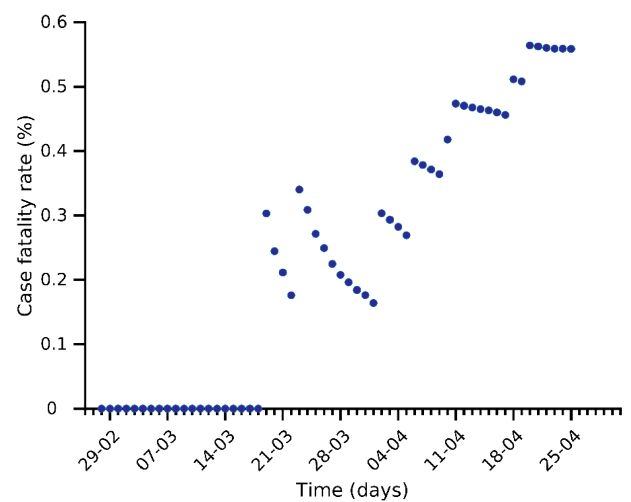
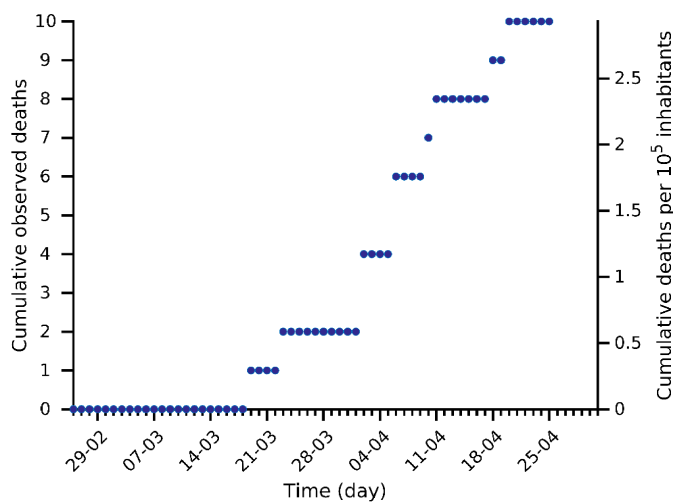
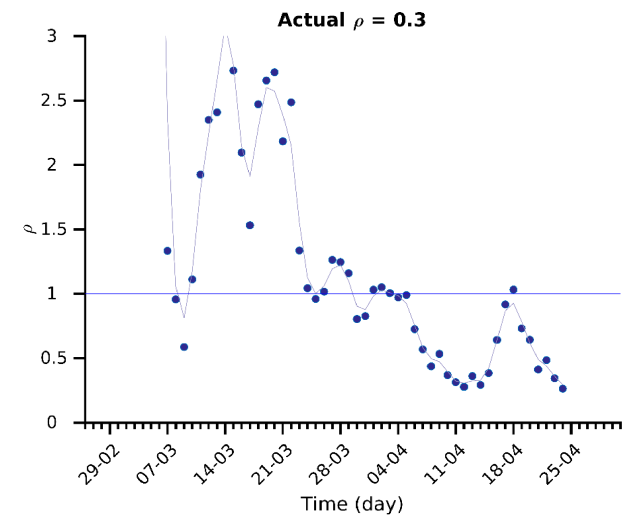
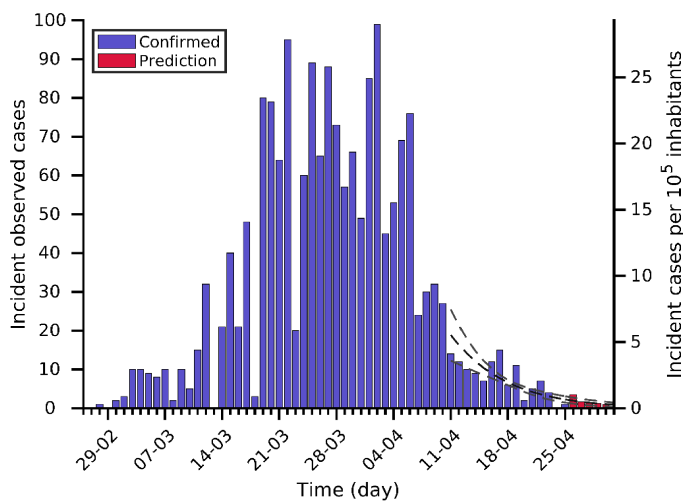
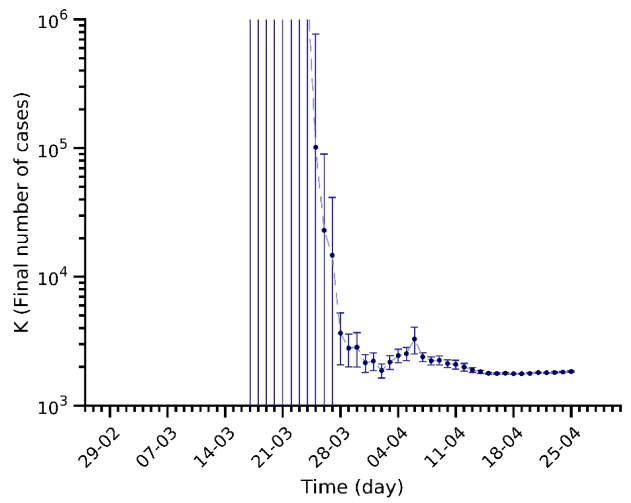
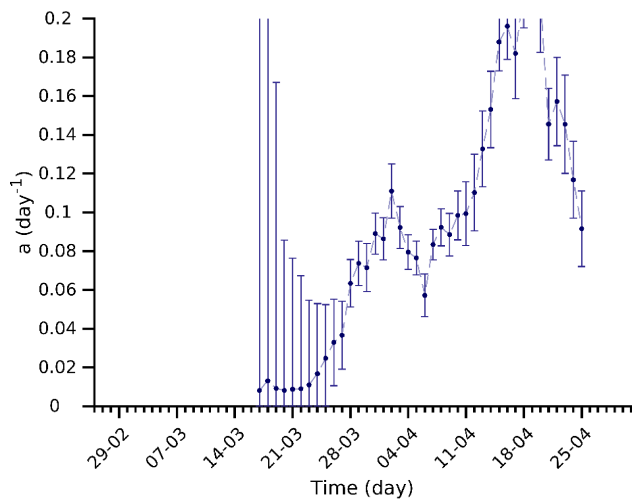
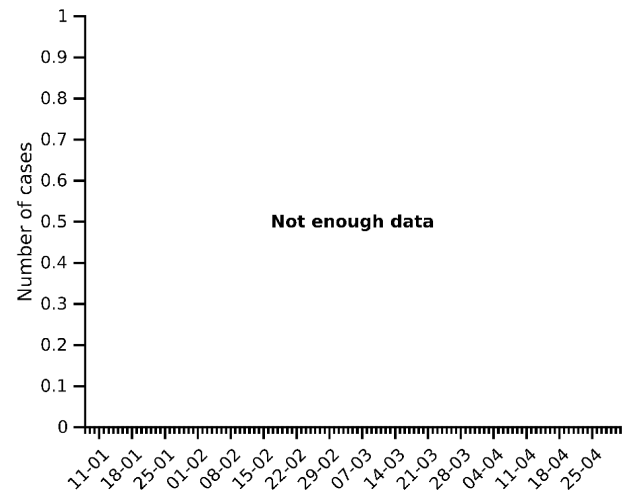
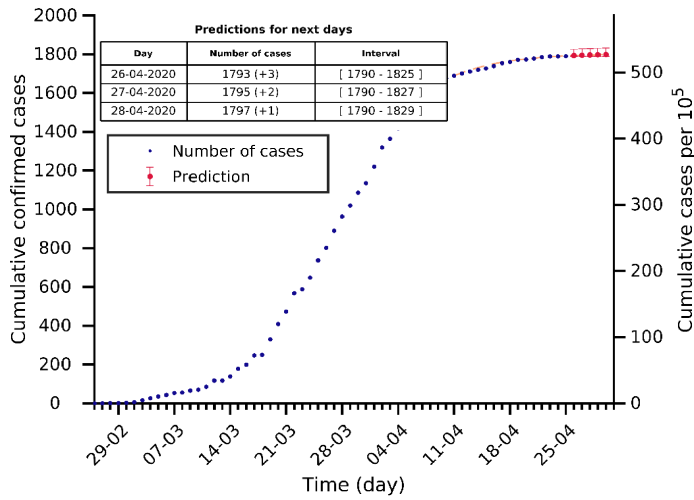
# Hungary 25-04-2020. Population: 9.7M. Current cumulated incidence: $26/10^5$



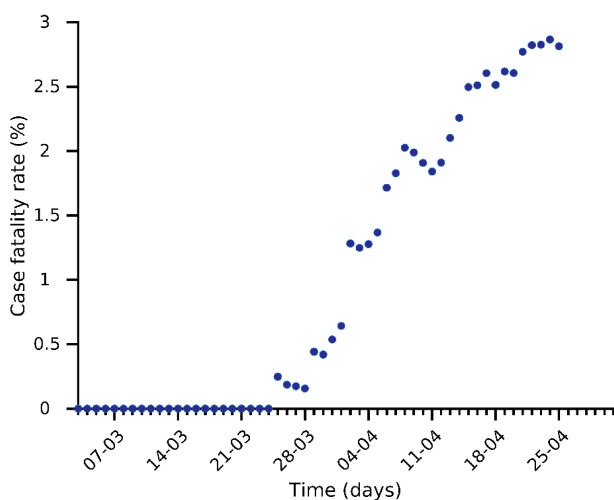
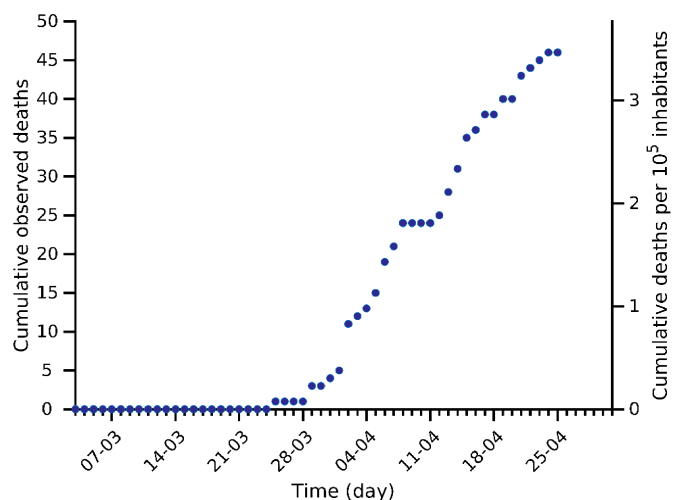
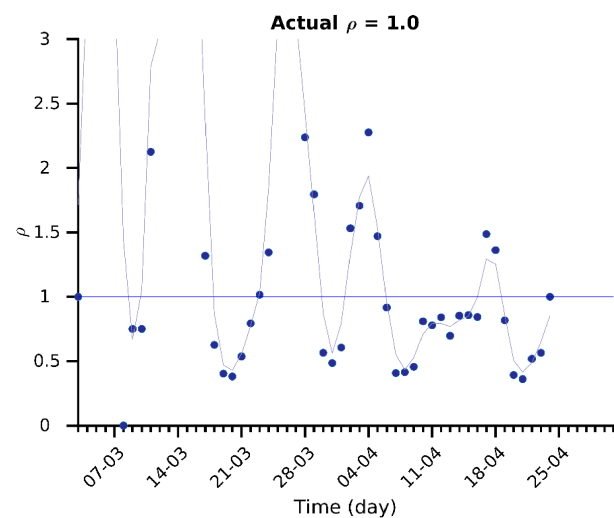
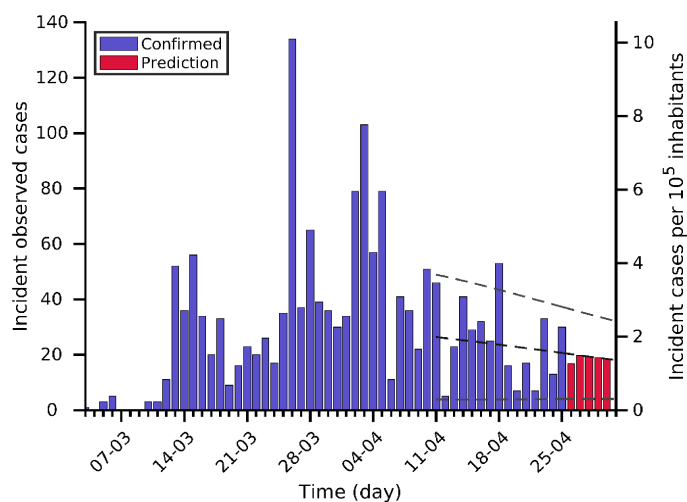
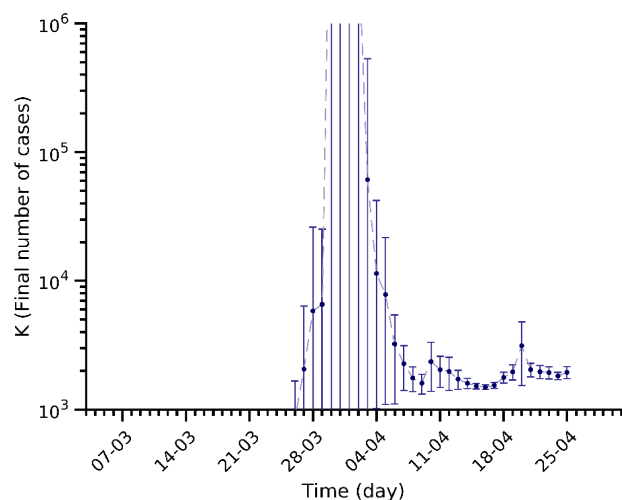
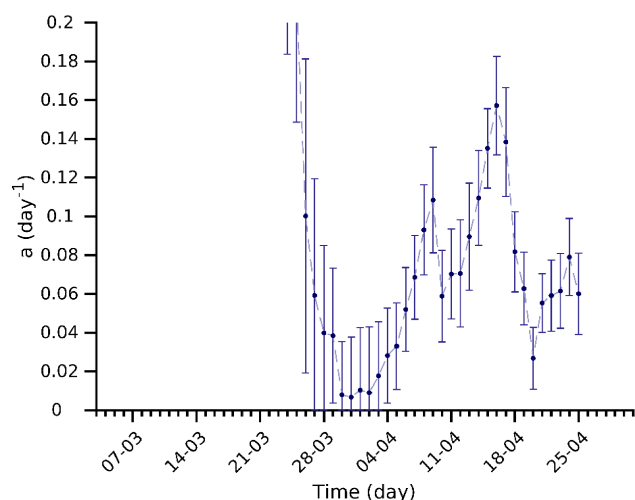
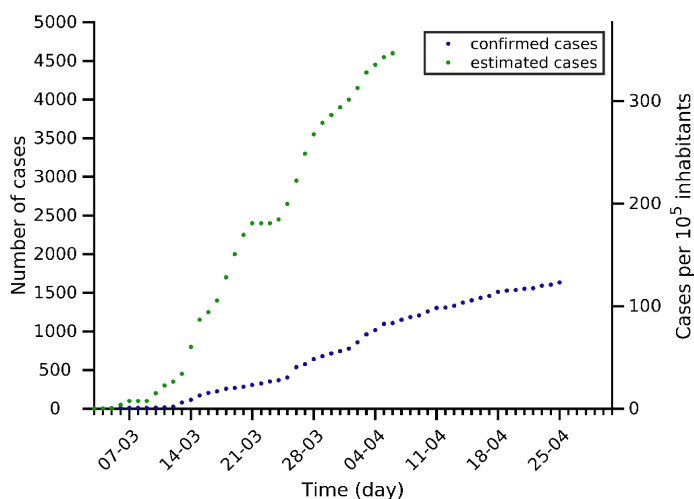
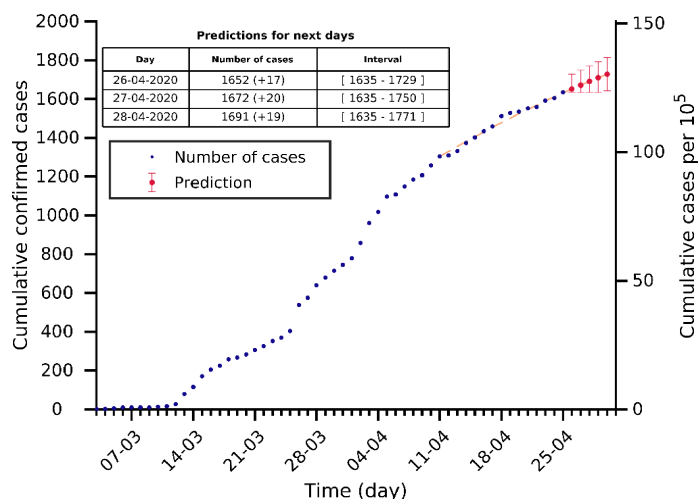
# Croatia 25-04-2020. Population: 4.1M. Current cumulated incidence: 49/10<sup>5</sup>



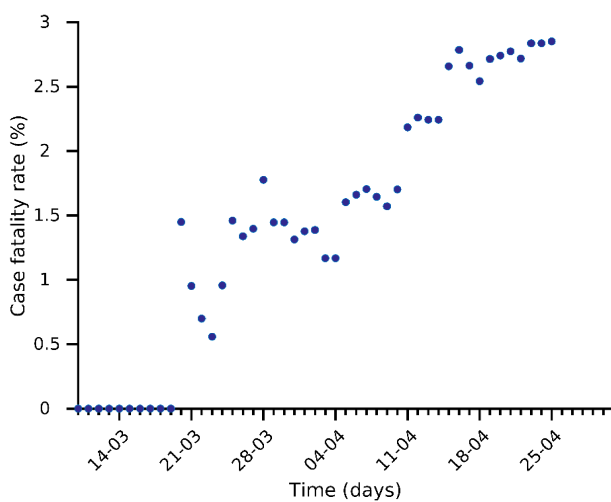
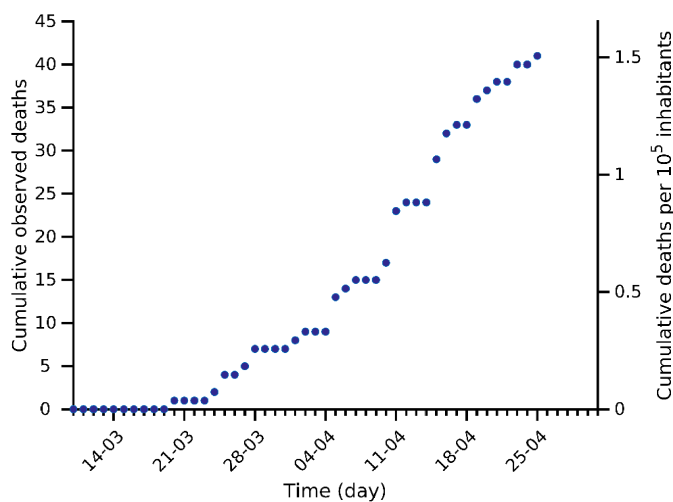
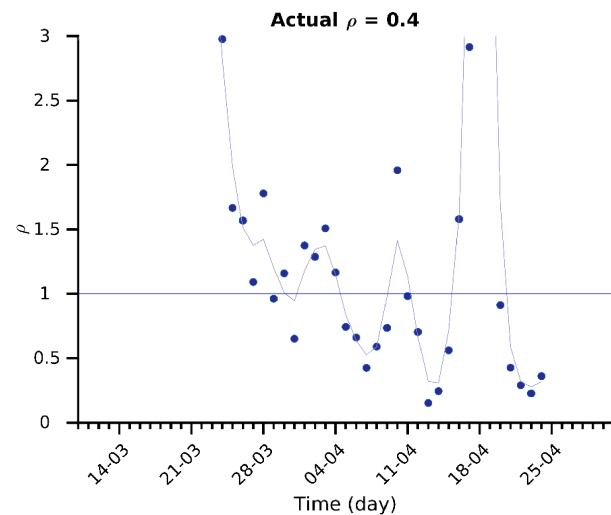
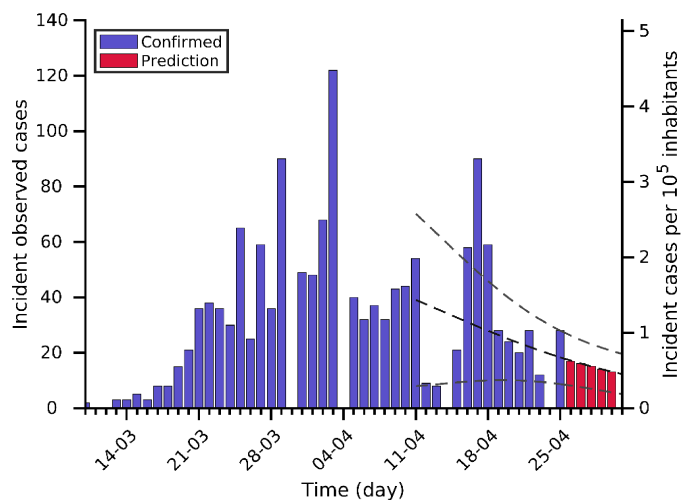
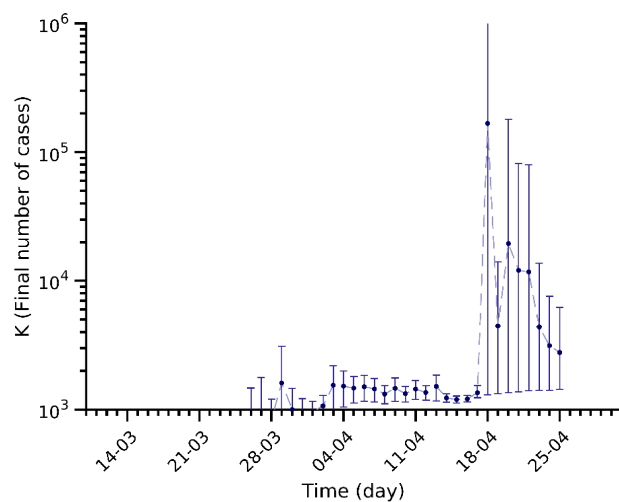
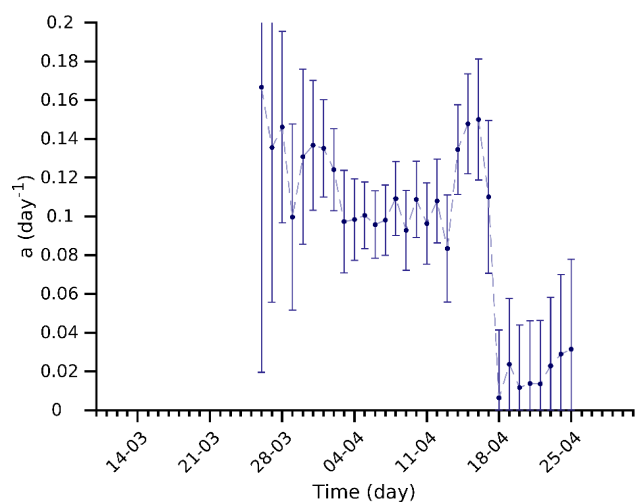
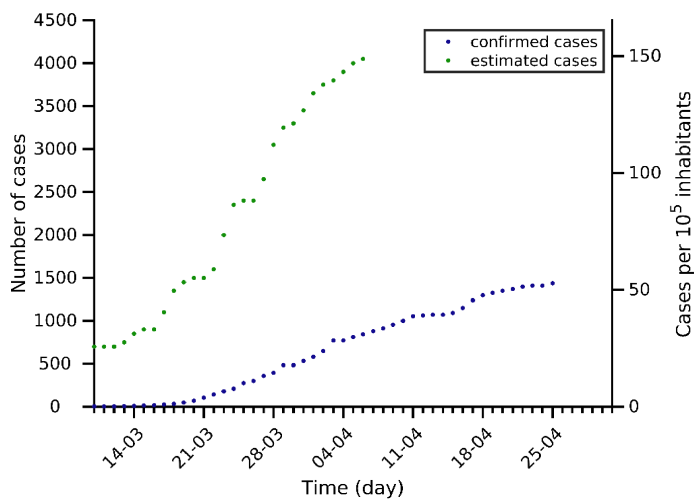
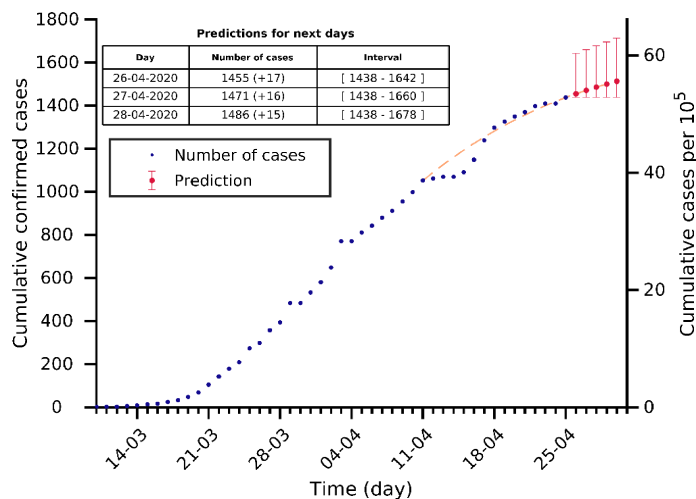
# Iceland 25-04-2020. Population: 0.3M. Current cumulated incidence: 525/10<sup>5</sup>



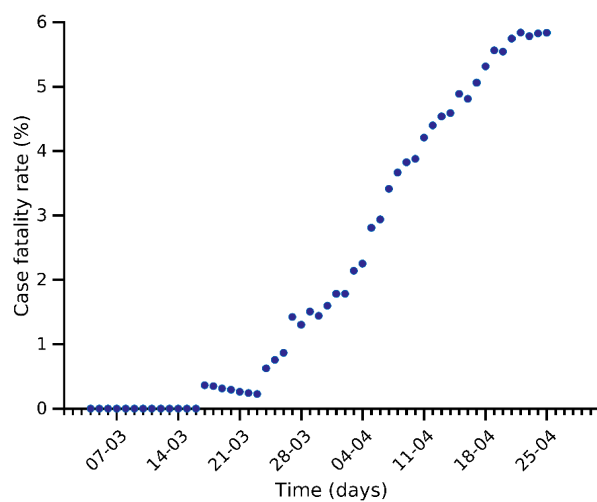
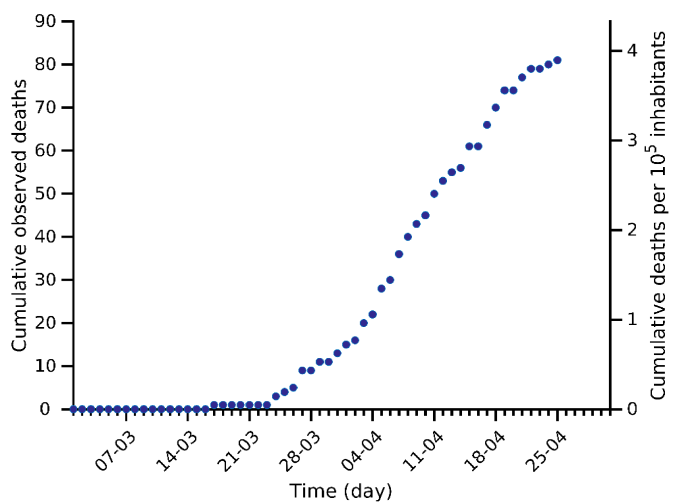
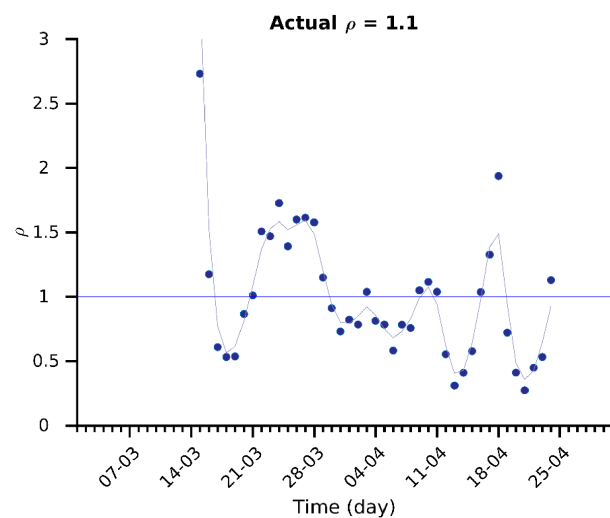
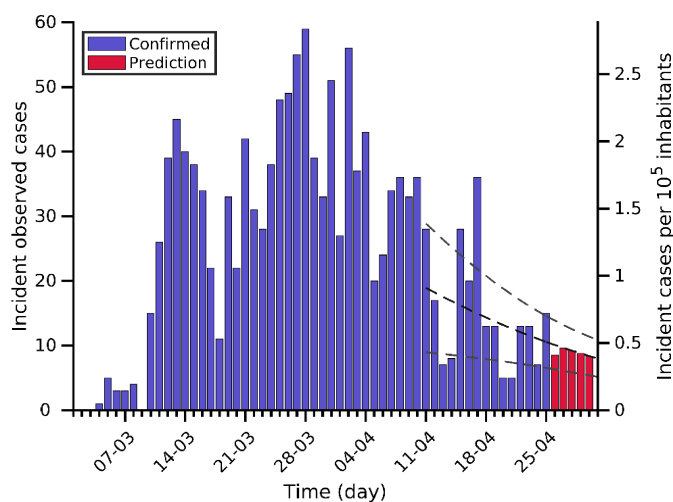
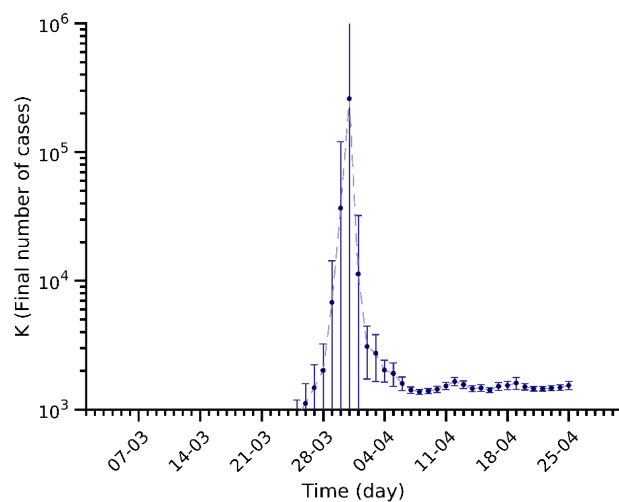
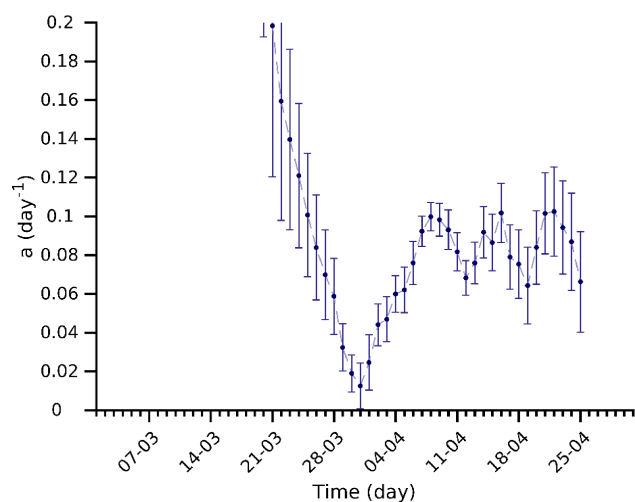
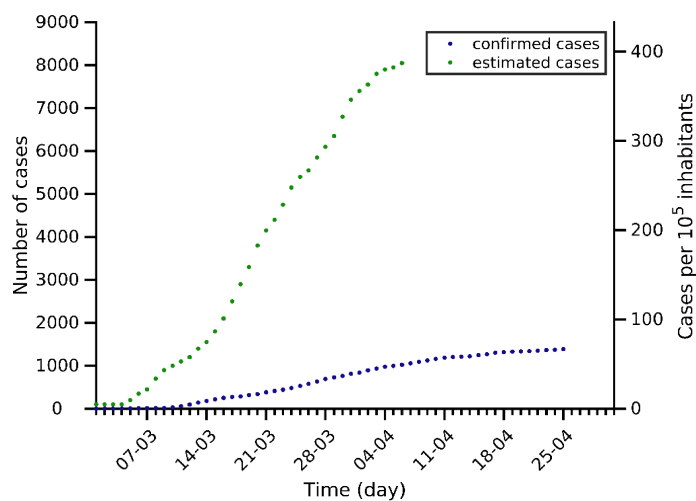
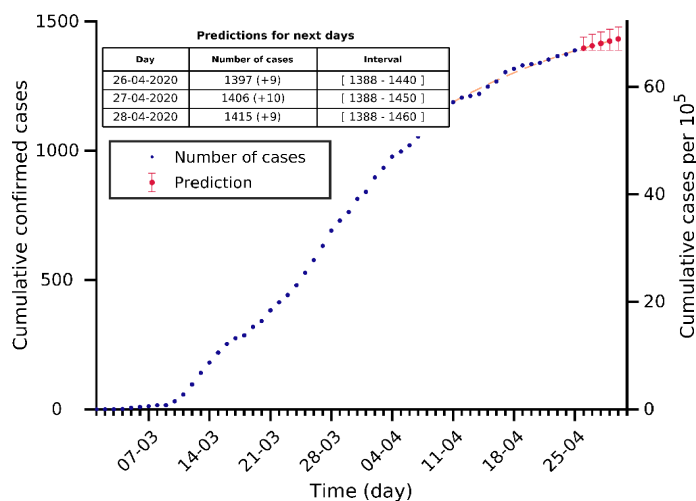
# Estonia 25-04-2020. Population: 1.3M. Current cumulated incidence: 123/10<sup>5</sup>



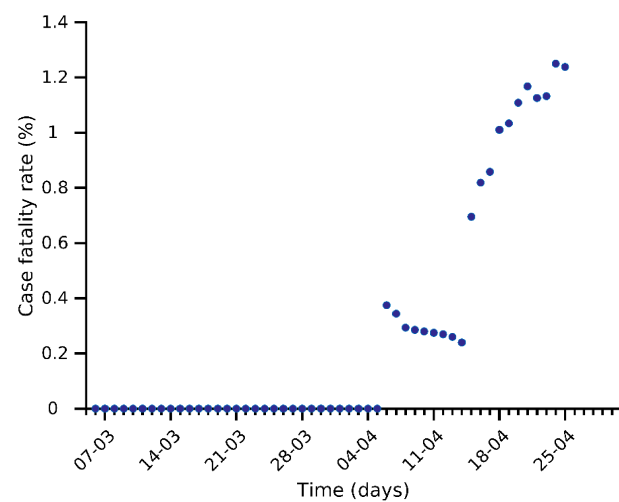
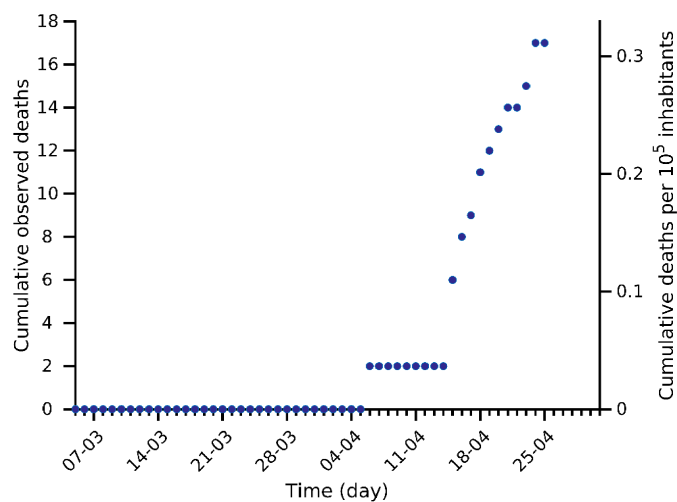
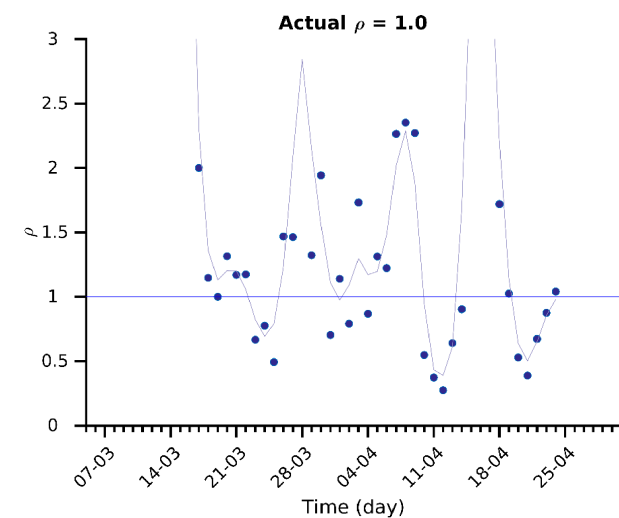
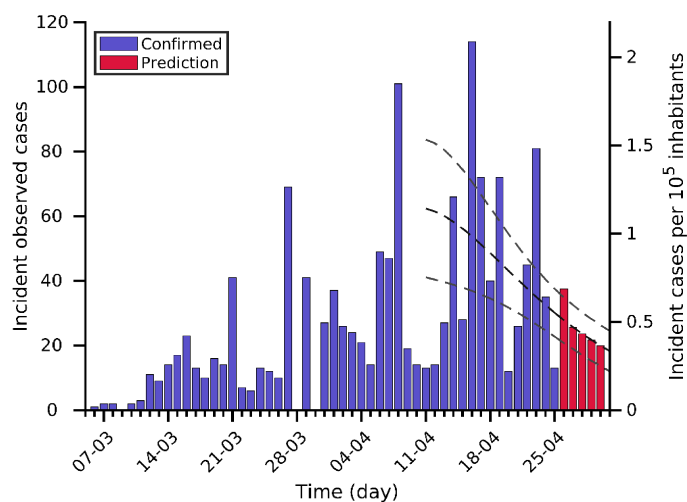
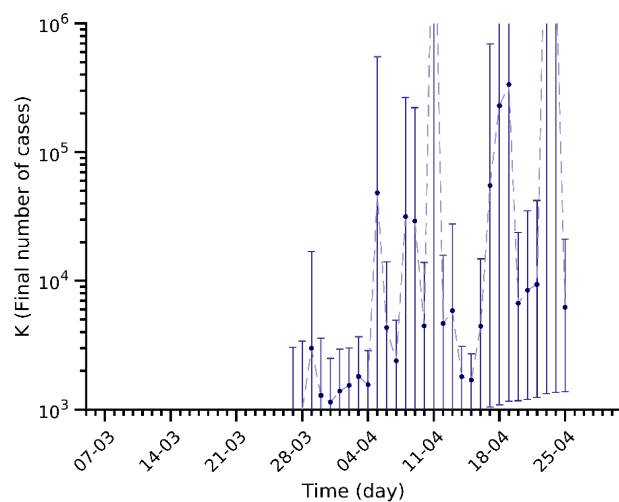
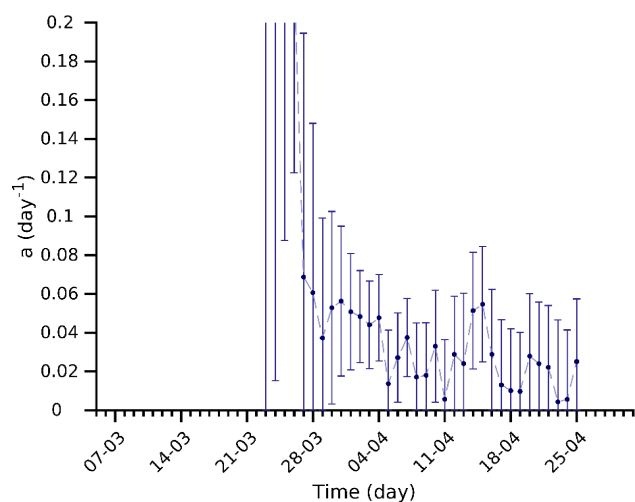
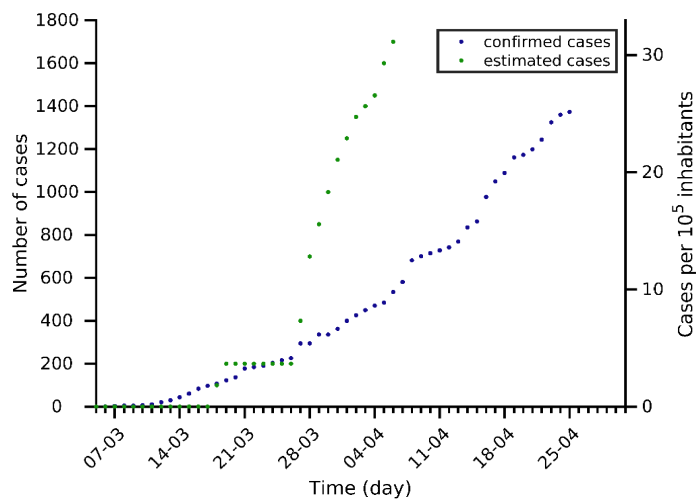
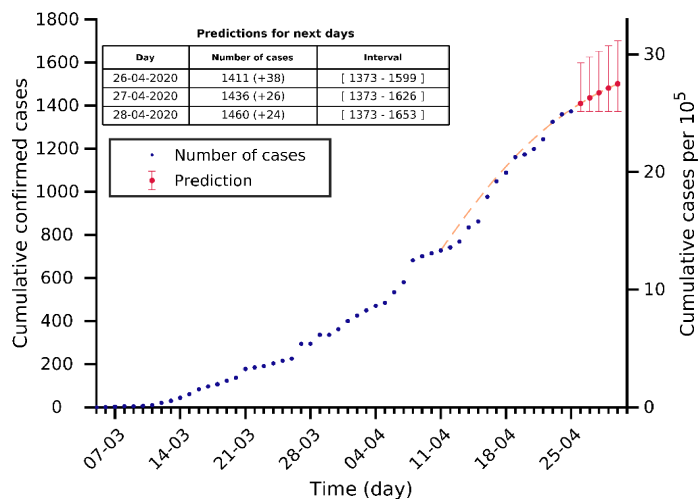
# Lithuania 25-04-2020. Population: 2.7M. Current cumulated incidence: 53/10<sup>5</sup>



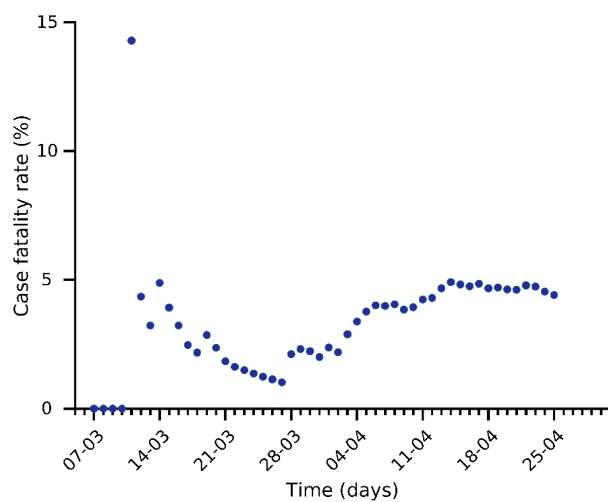
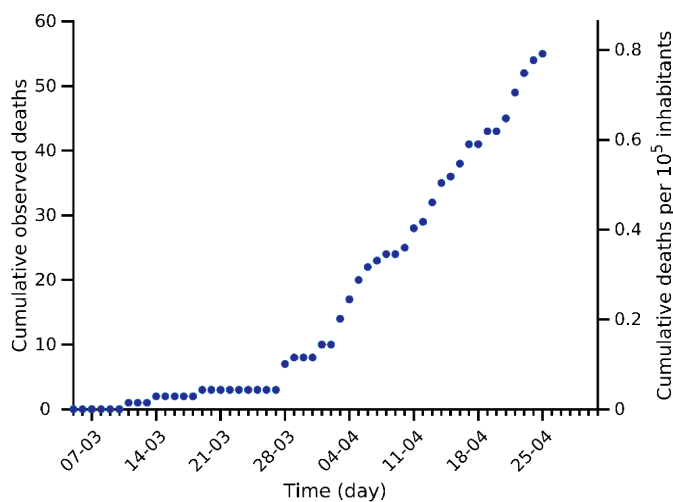
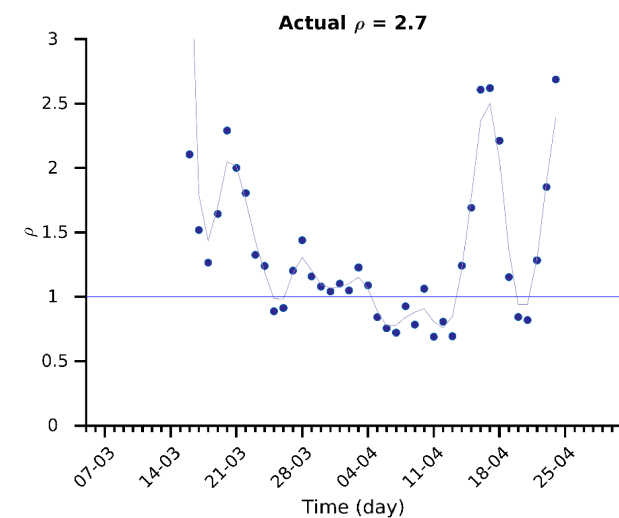
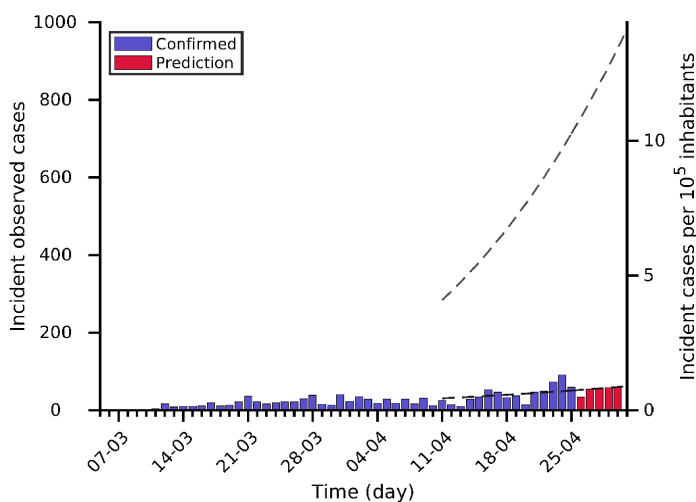
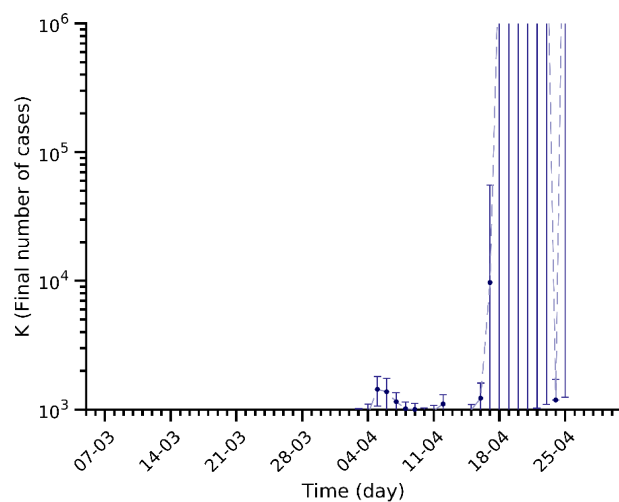
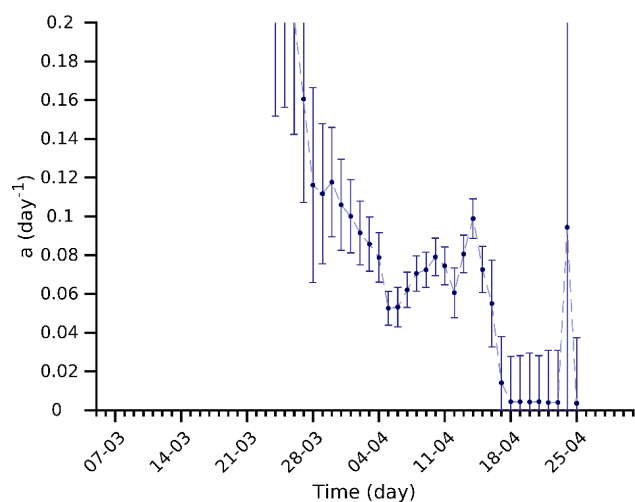
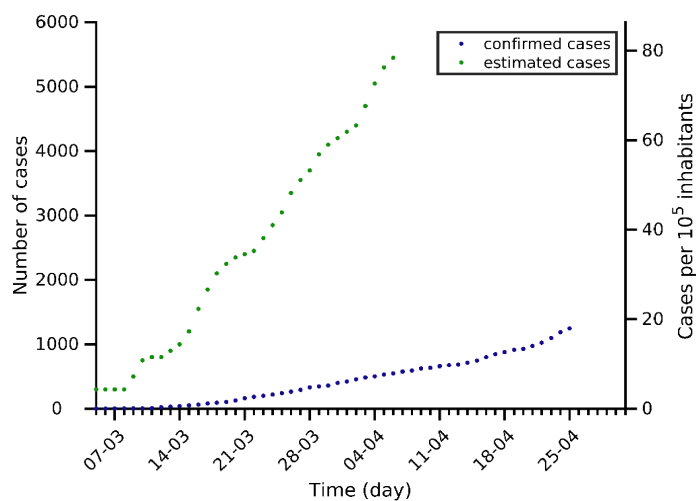
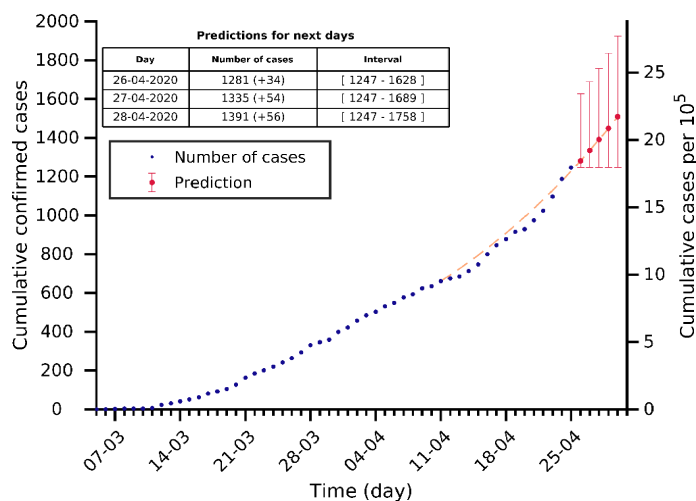
# Slovenia 25-04-2020. Population: 2.1M. Current cumulated incidence: 67/10<sup>5</sup>



# Slovakia 25-04-2020. Population: 5.5M. Current cumulated incidence: 25/10<sup>5</sup>

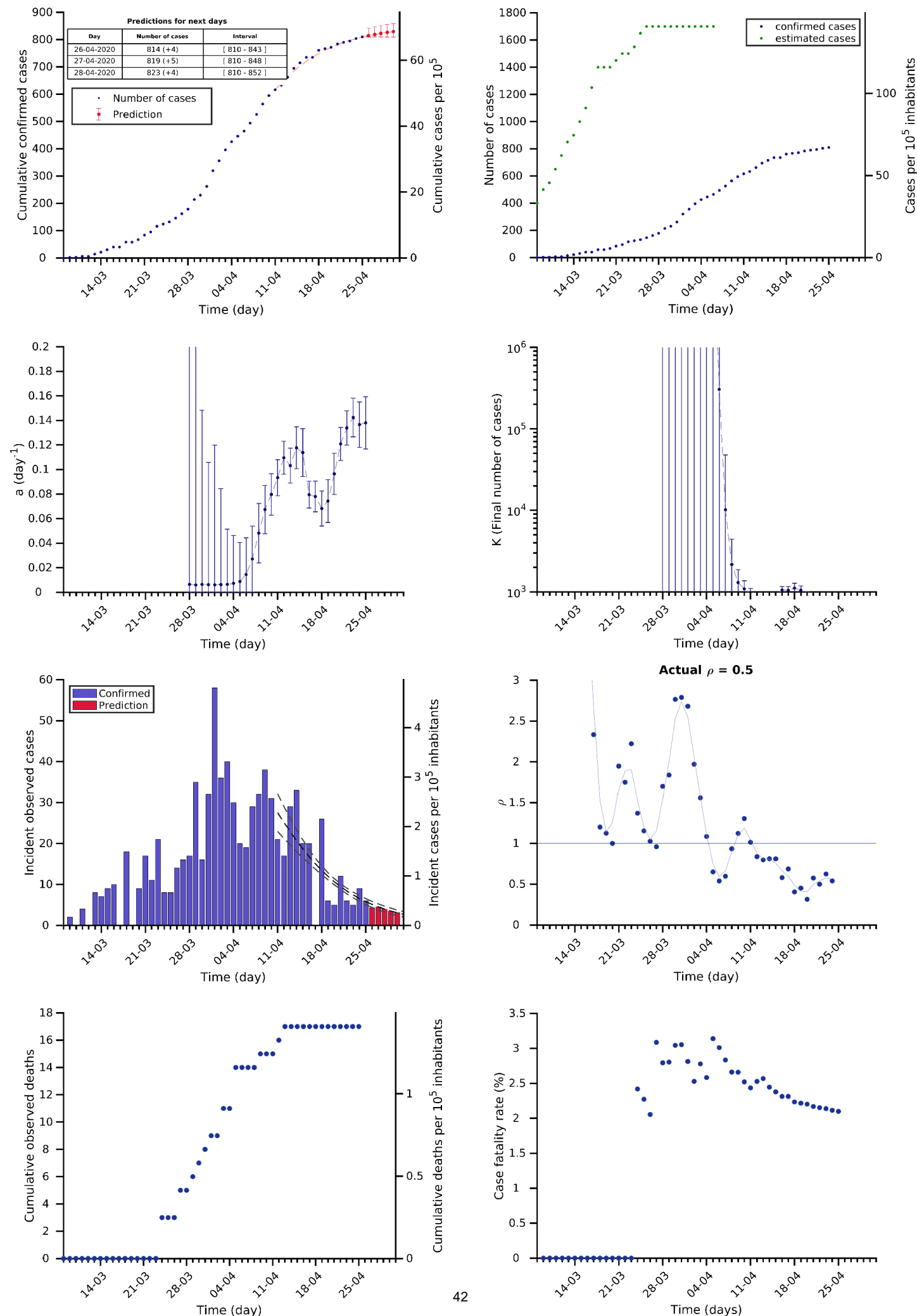


# Bulgaria 25-04-2020. Population: 6.9M. Current cumulated incidence: 18/10<sup>5</sup>

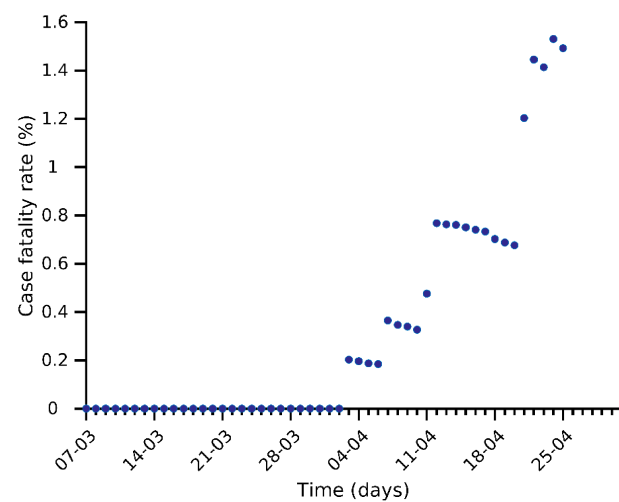
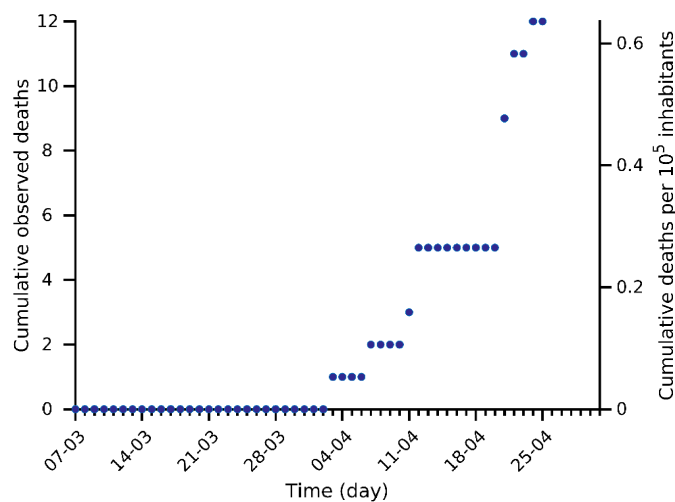
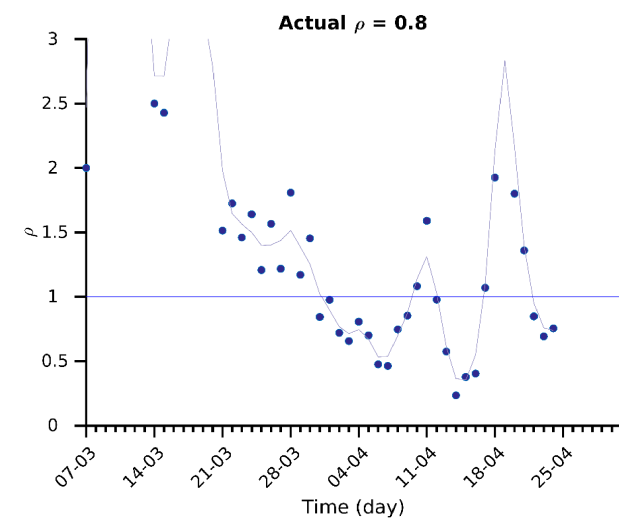
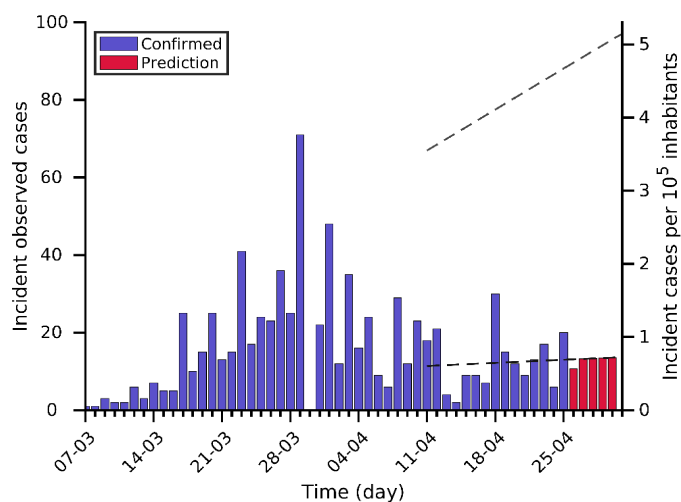
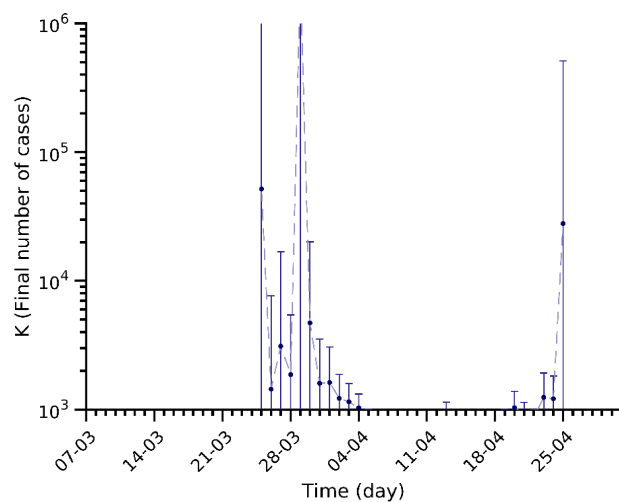
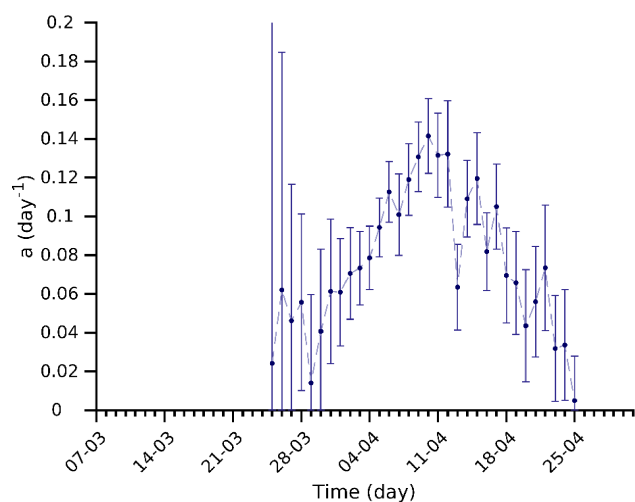
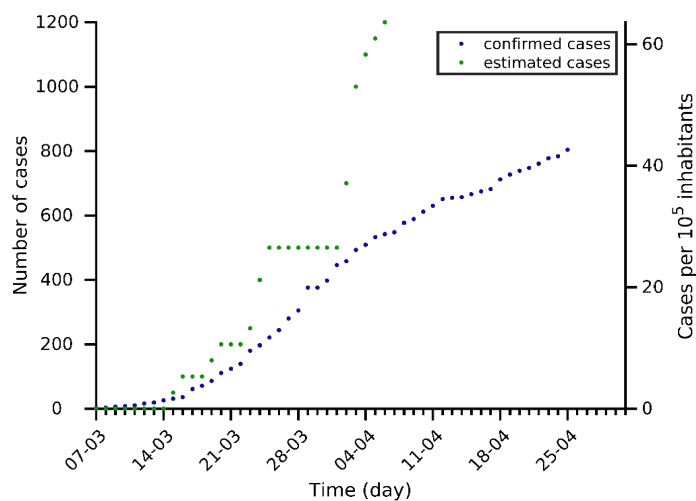
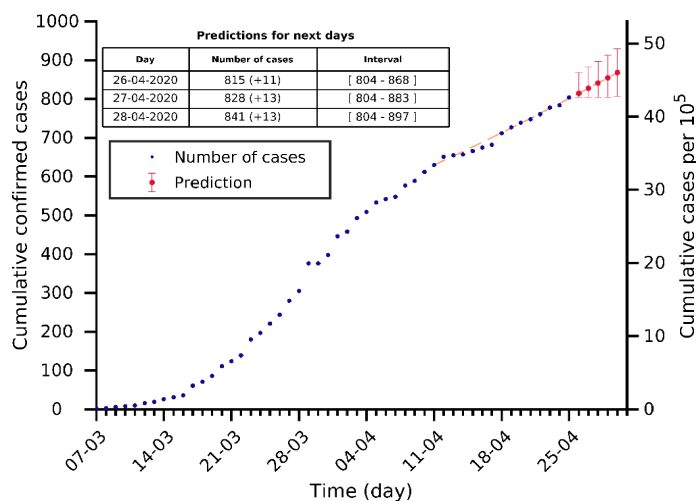




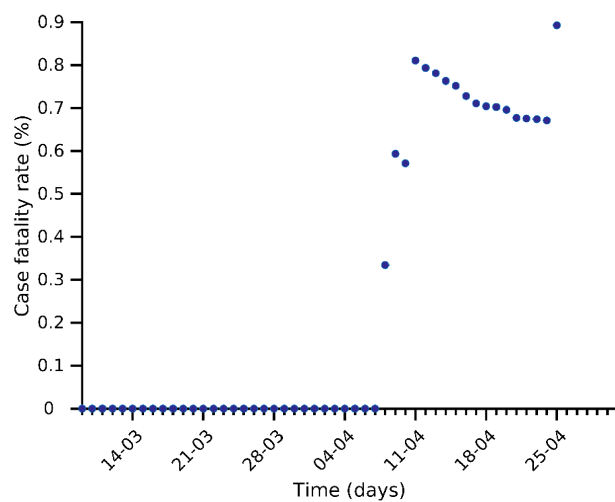
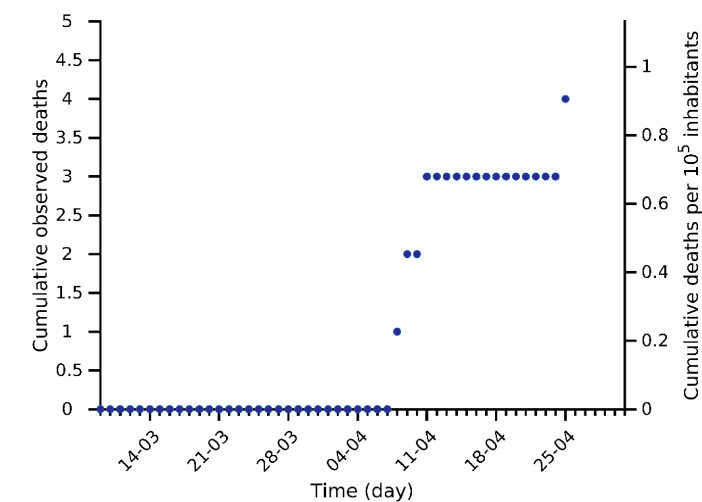
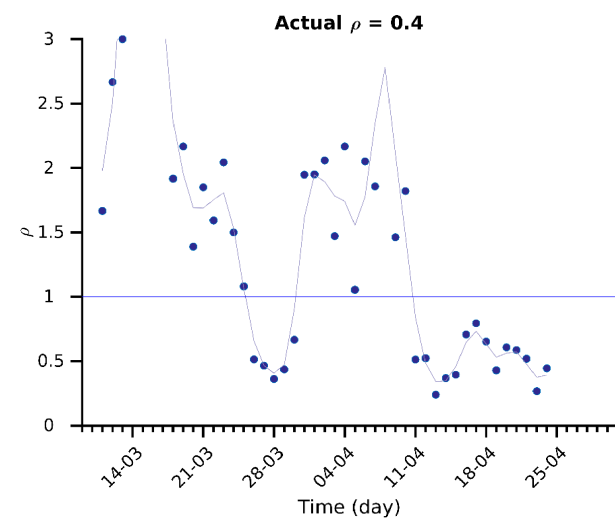
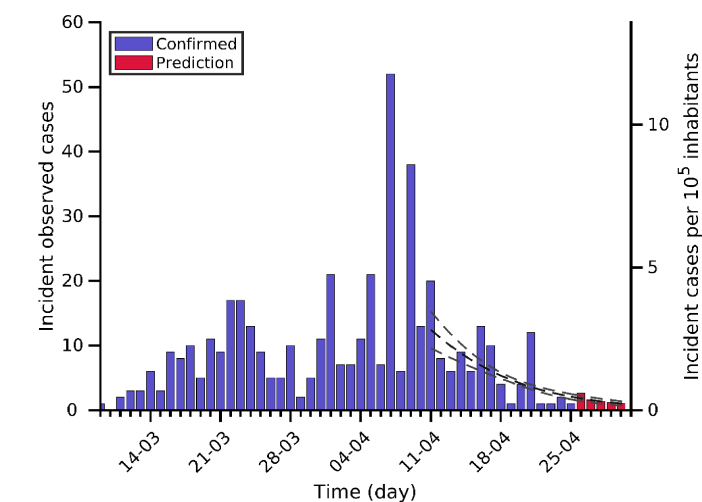
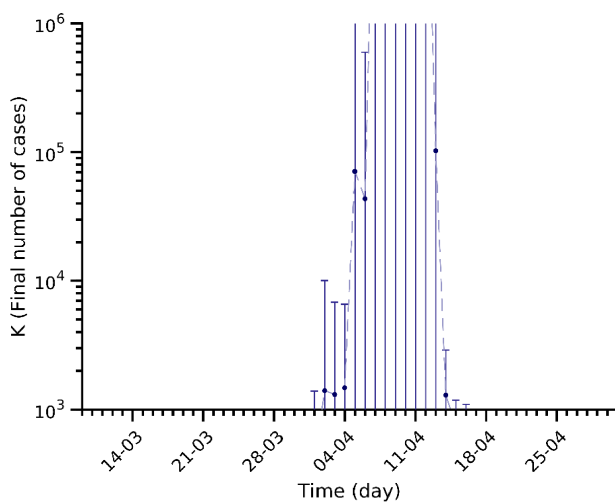
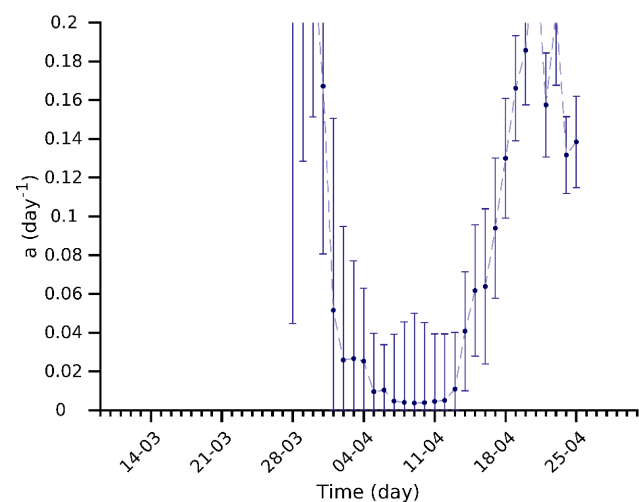
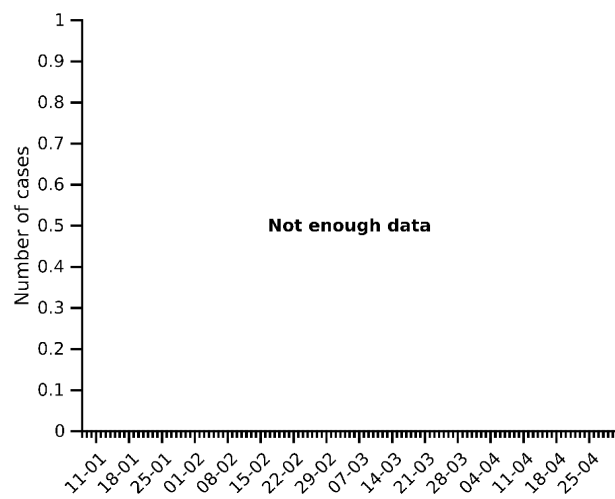
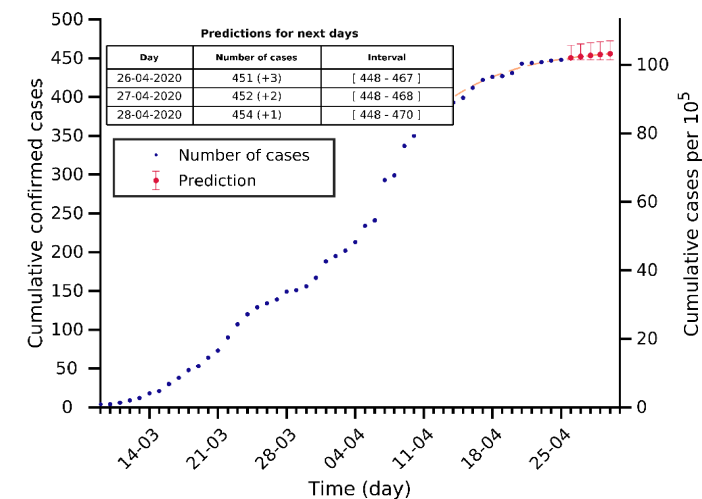
# Cyprus 25-04-2020. Population: 1.2M. Current cumulated incidence: 67/10<sup>5</sup>



# Latvia 25-04-2020. Population: 1.9M. Current cumulated incidence: 43/10<sup>5</sup>



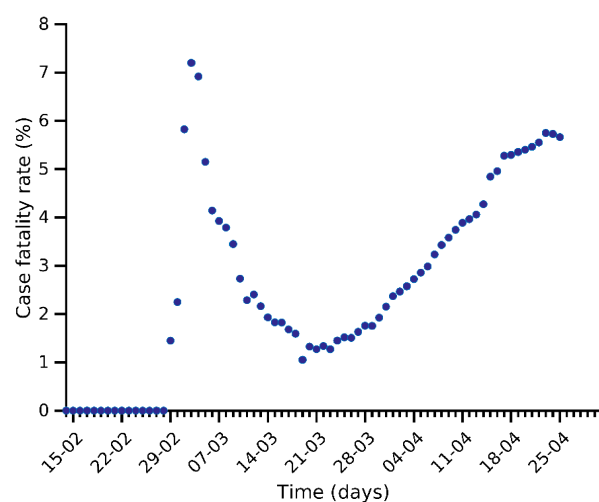
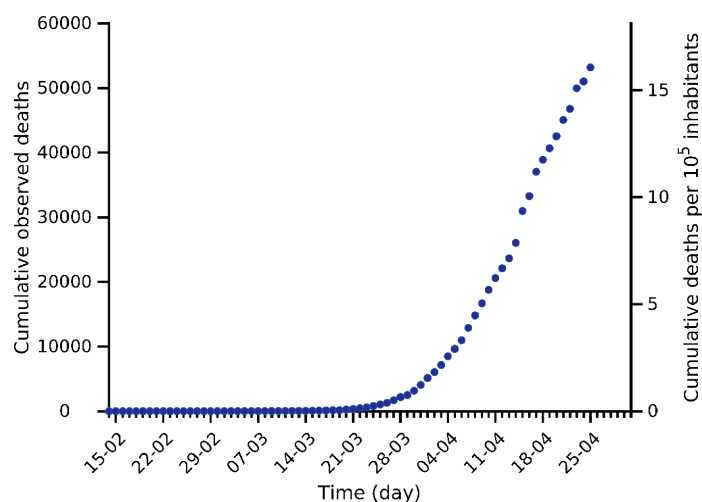
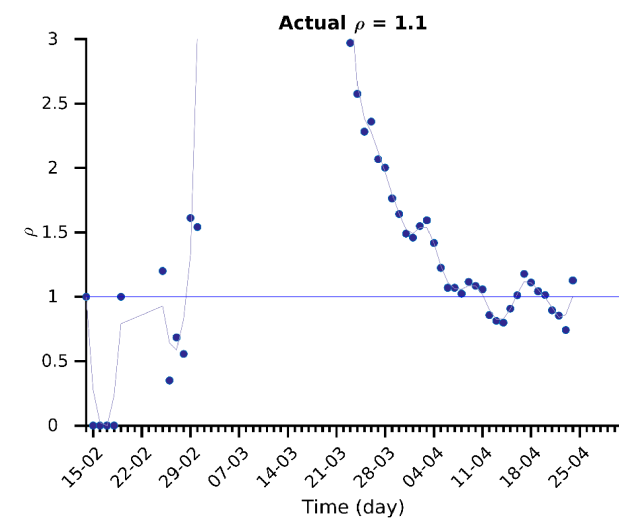
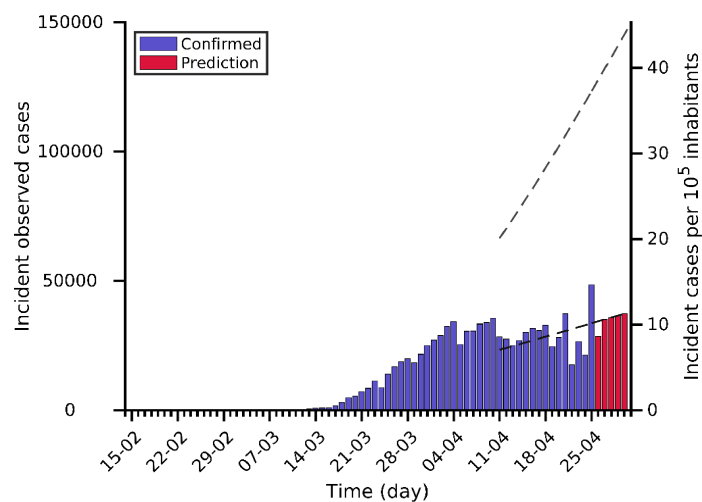
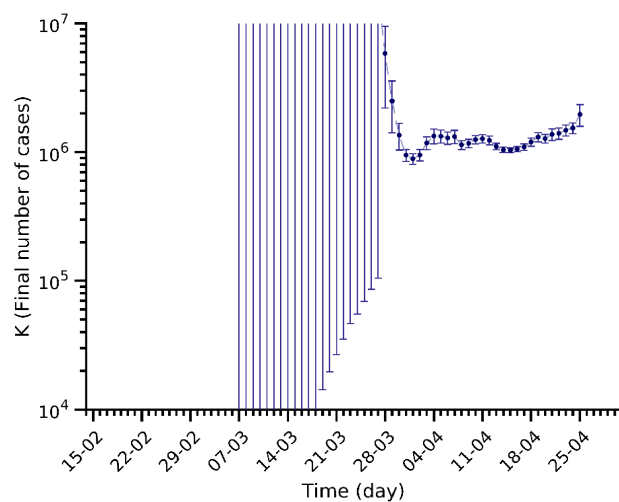
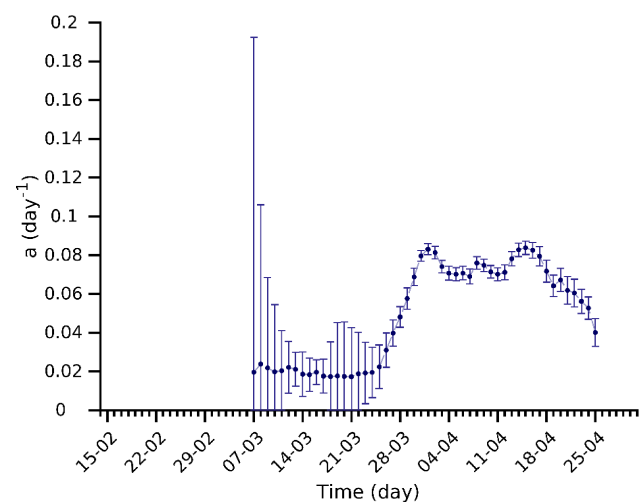
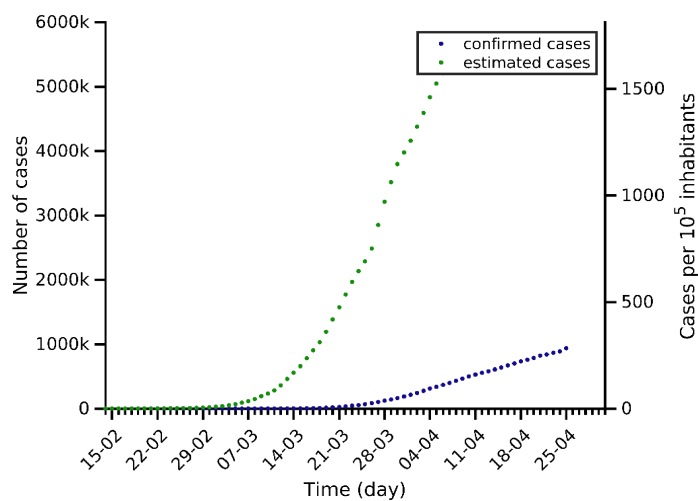
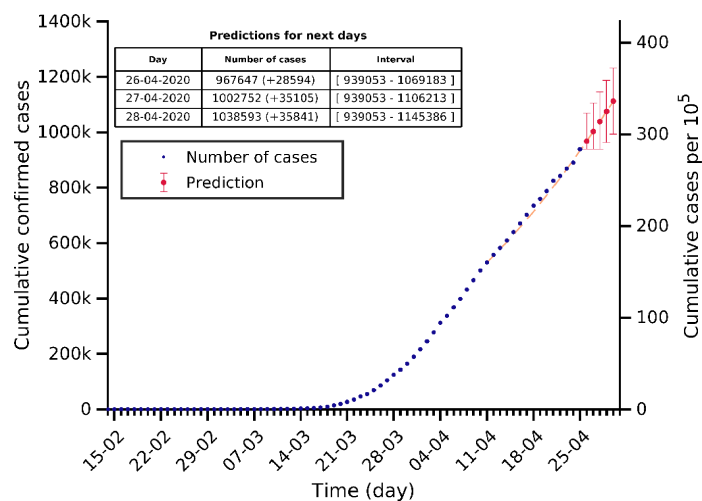
# Malta 25-04-2020. Population: 0.4M. Current cumulated incidence: 101/10<sup>5</sup>



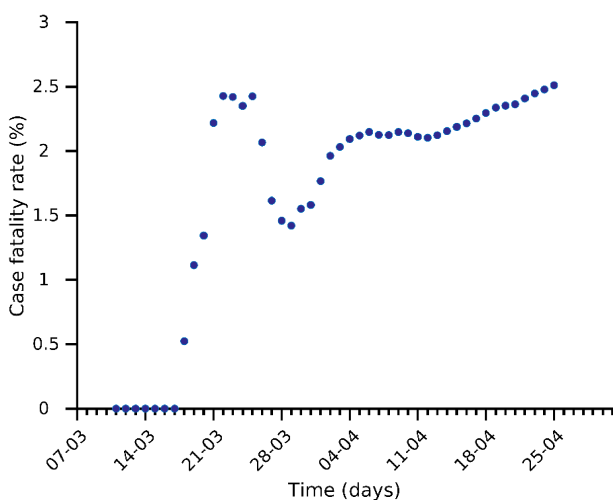
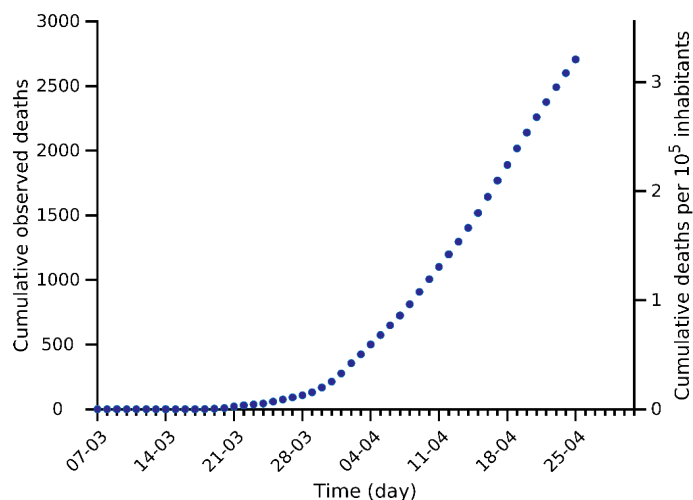
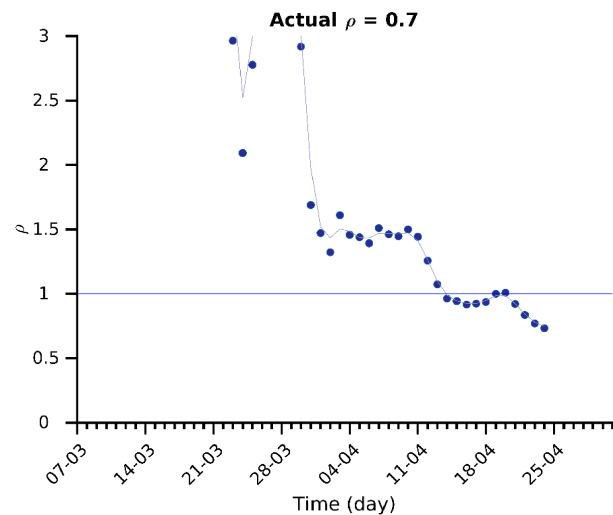
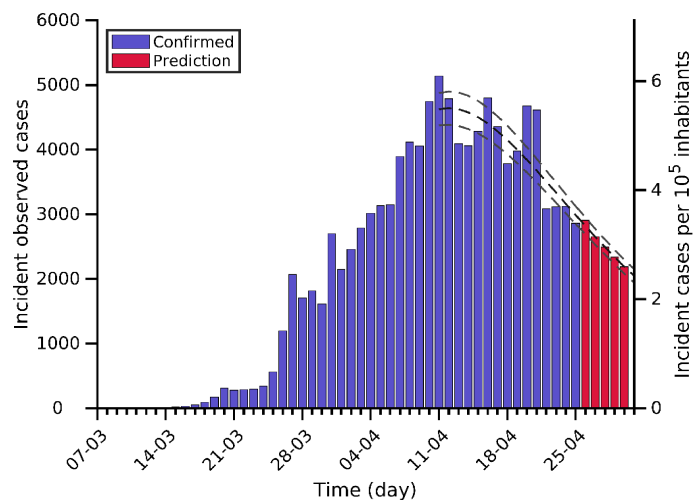
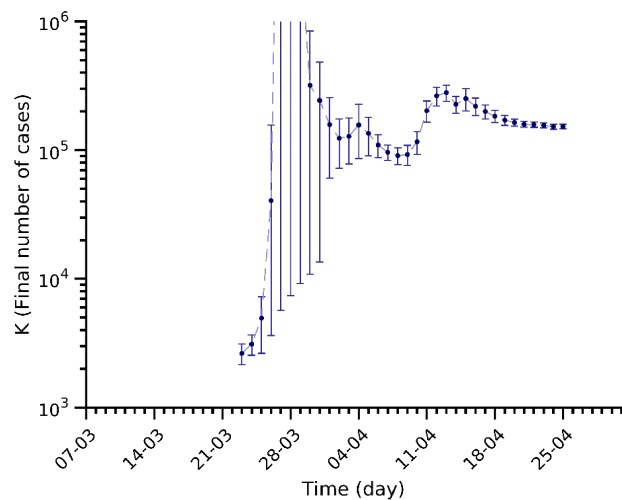
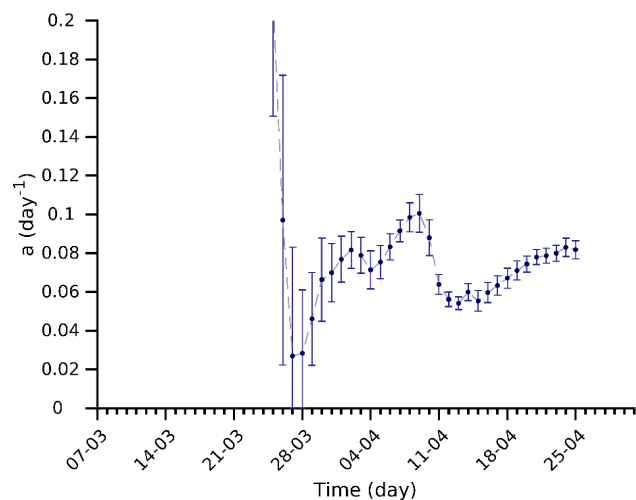
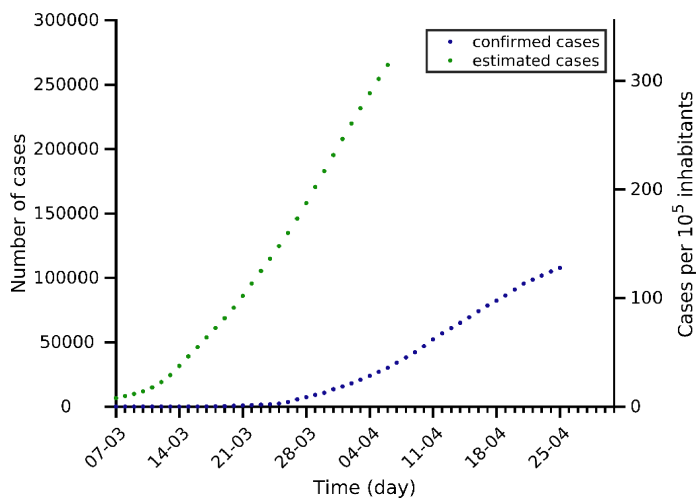
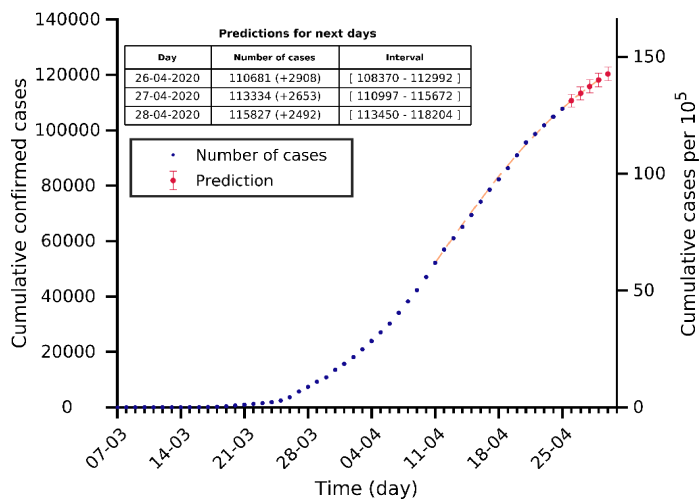
## **(2) Analysis and prediction of COVID-19 for other countries**

Data obtained from <https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases>

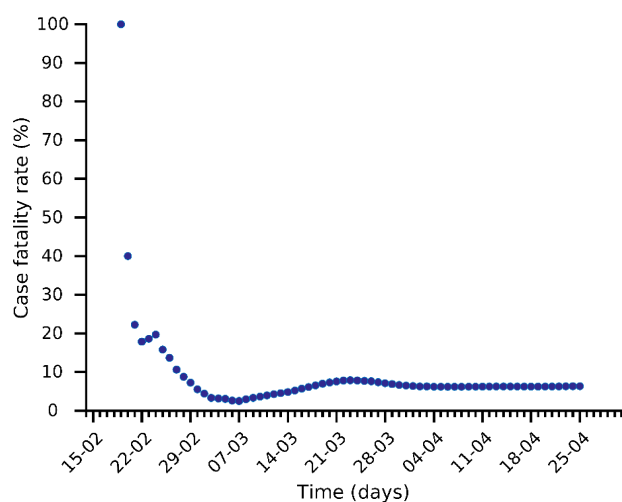
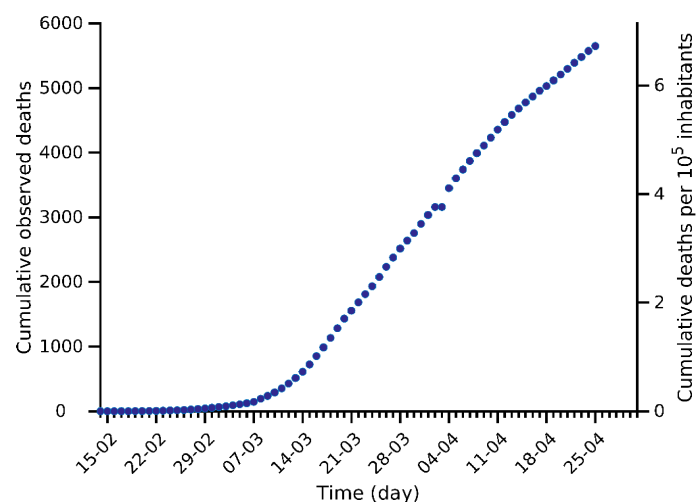
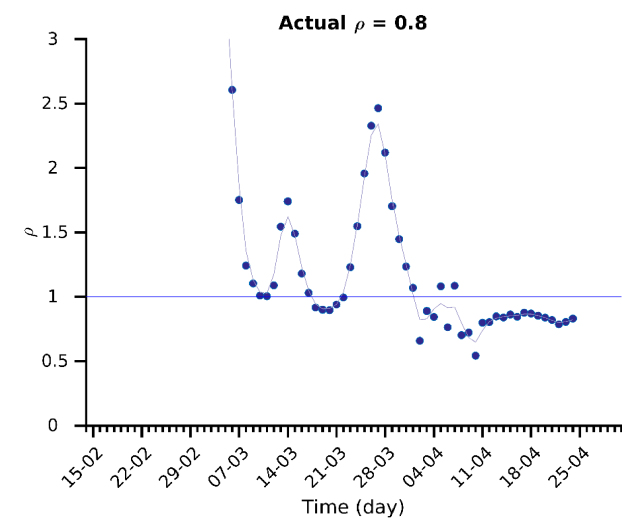
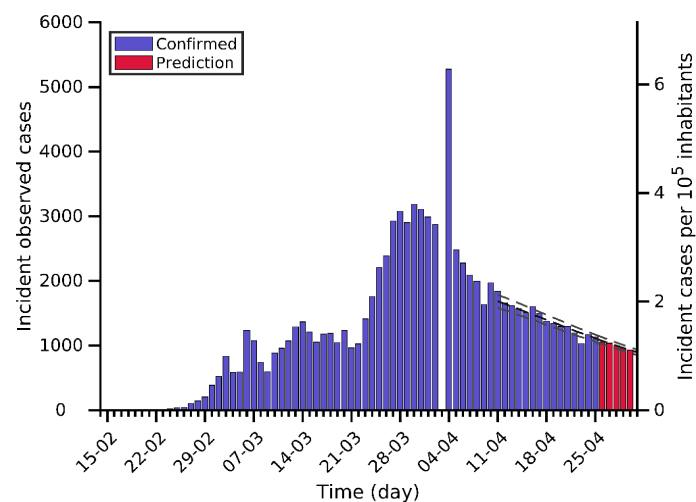
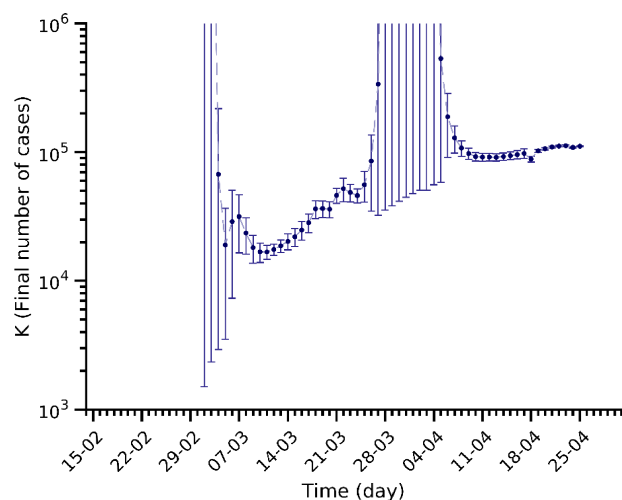
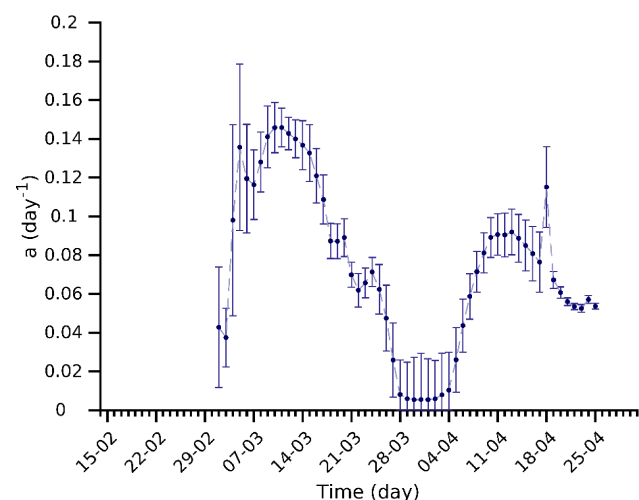
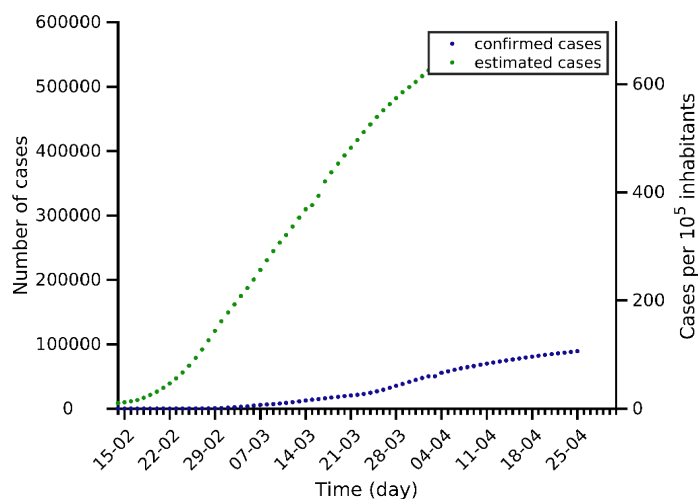
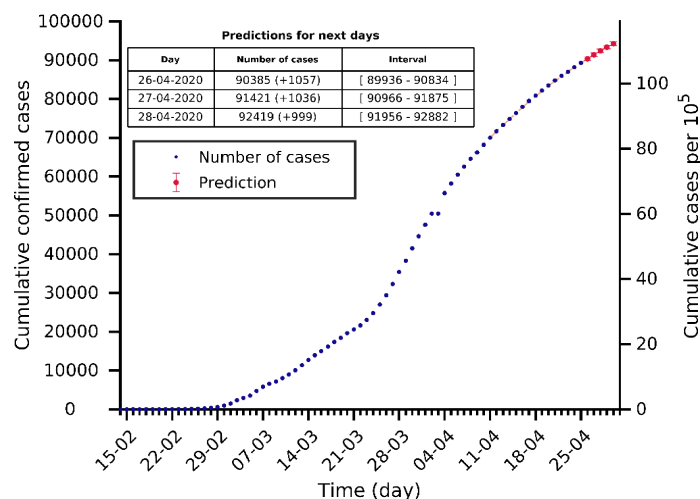
# USA 25-04-2020. Population: 331.0M. Current cumulated incidence: 284/10<sup>5</sup>



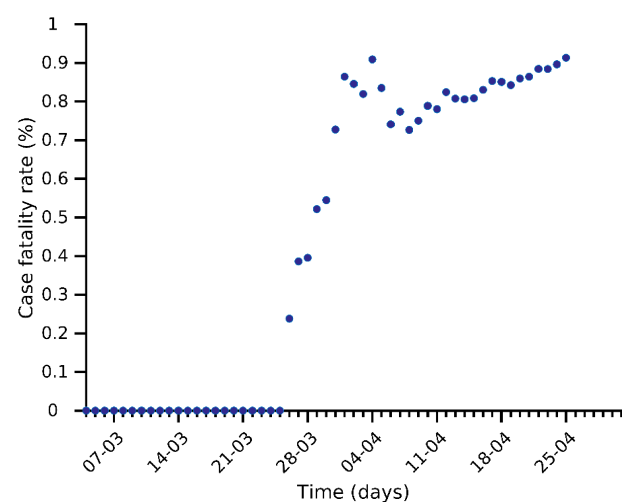
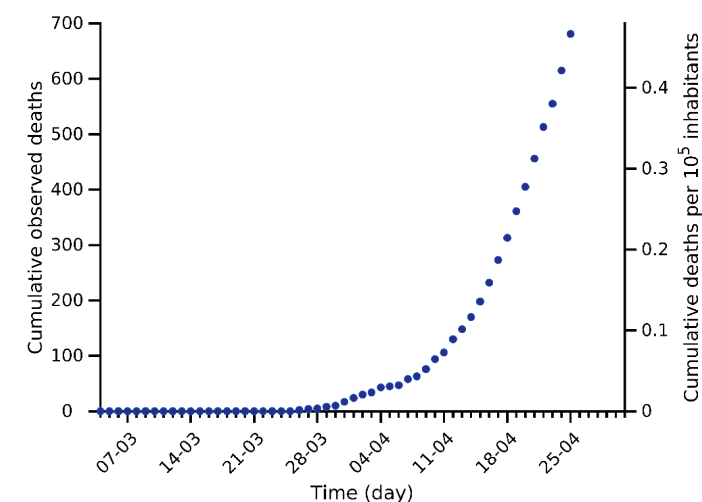
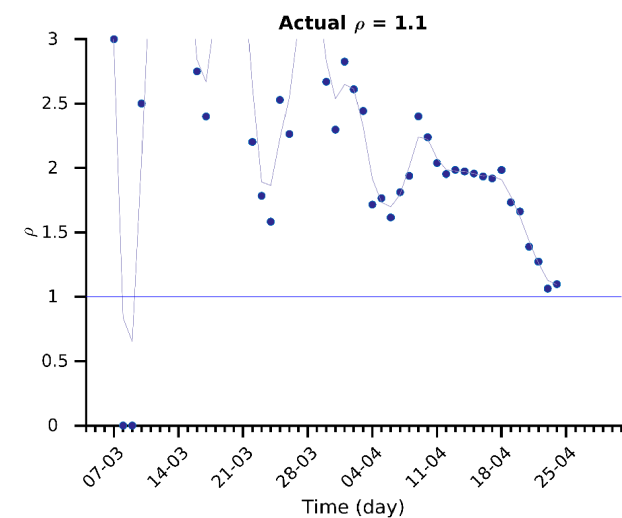
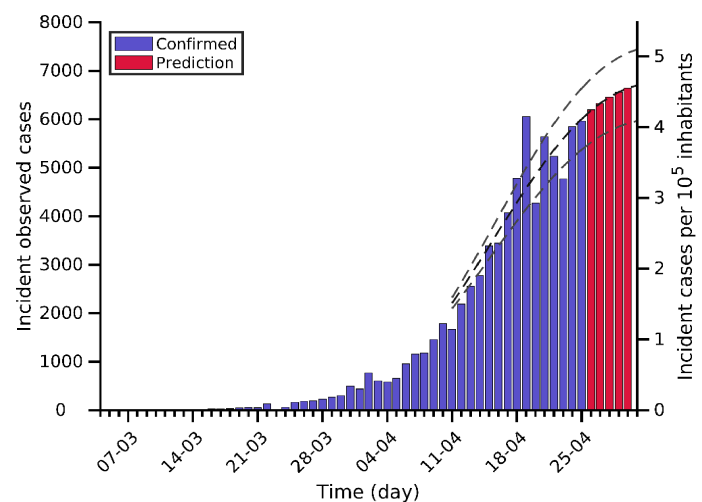
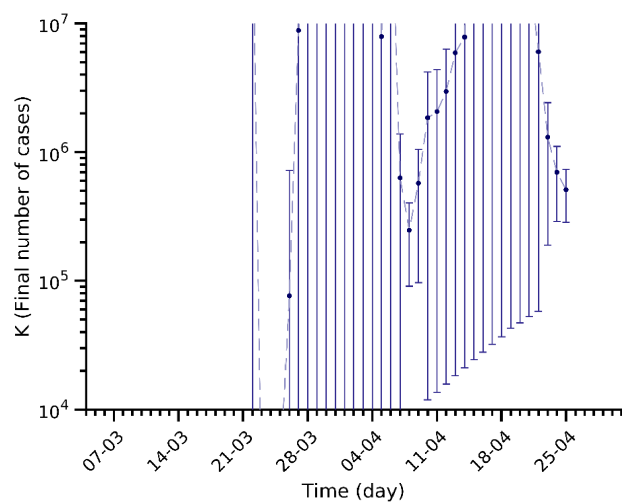
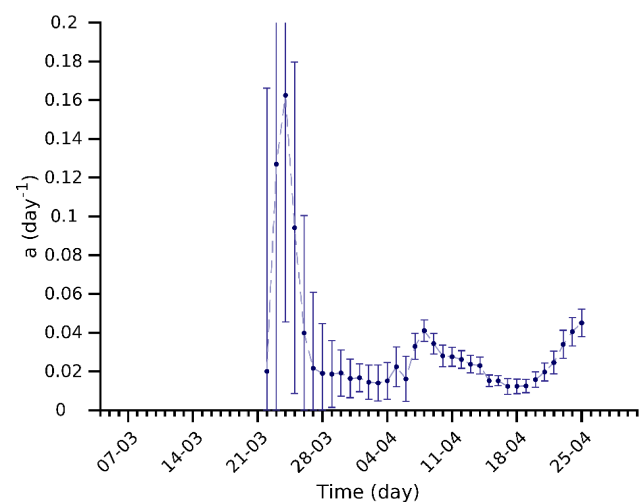
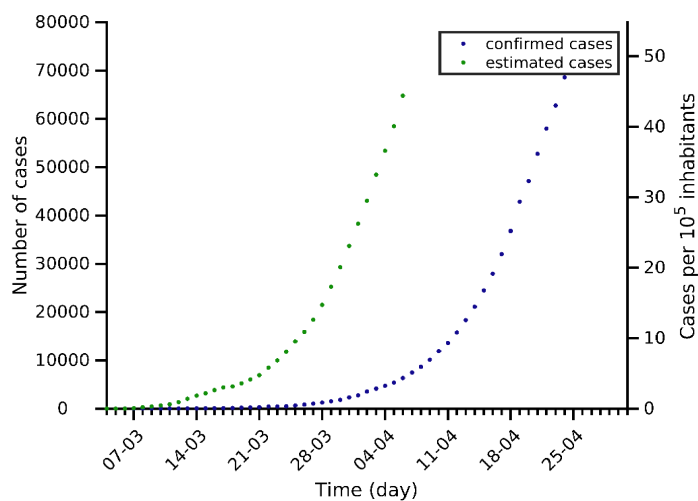
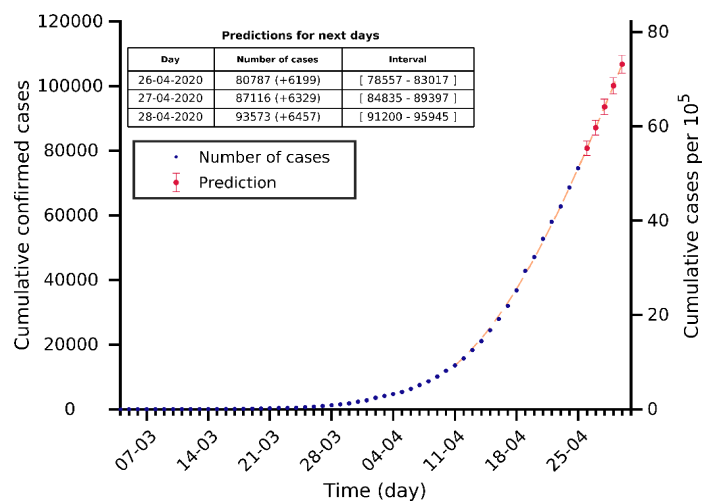
# Turkey 25-04-2020. Population: 84.3M. Current cumulated incidence: 128/10<sup>5</sup>



# Iran 25-04-2020. Population: 84.0M. Current cumulated incidence: 106/10<sup>5</sup>

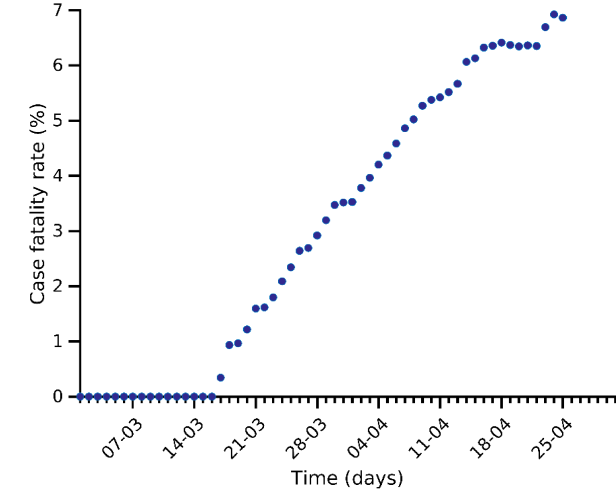
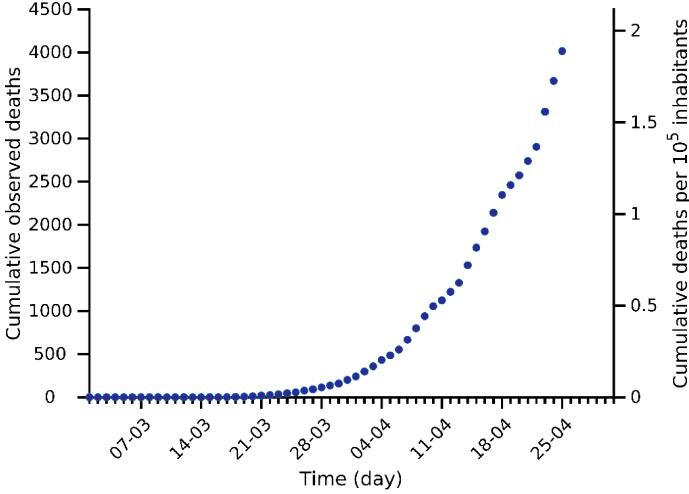
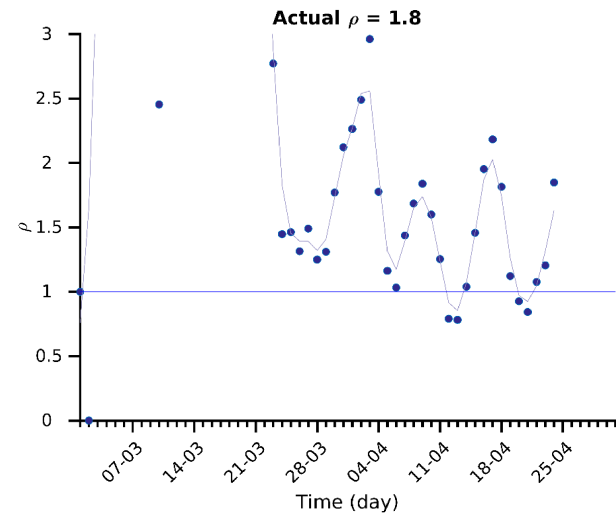
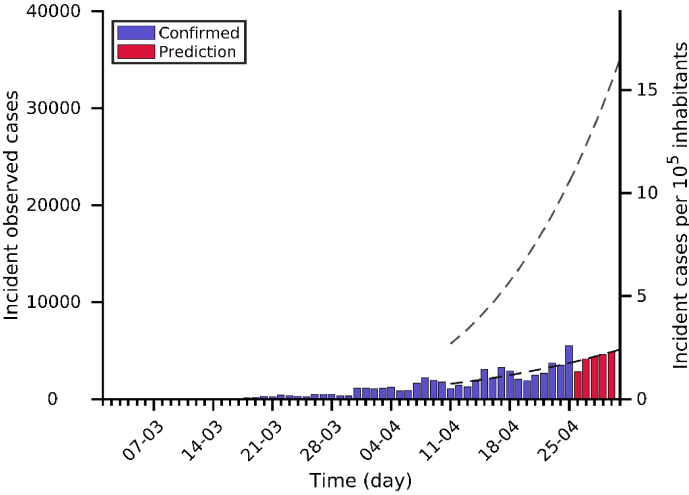
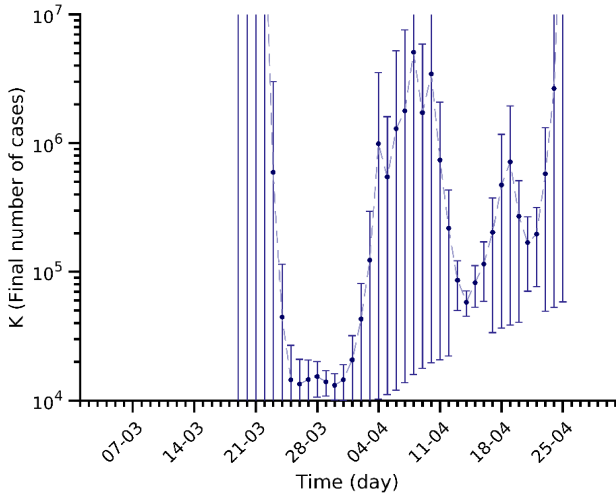
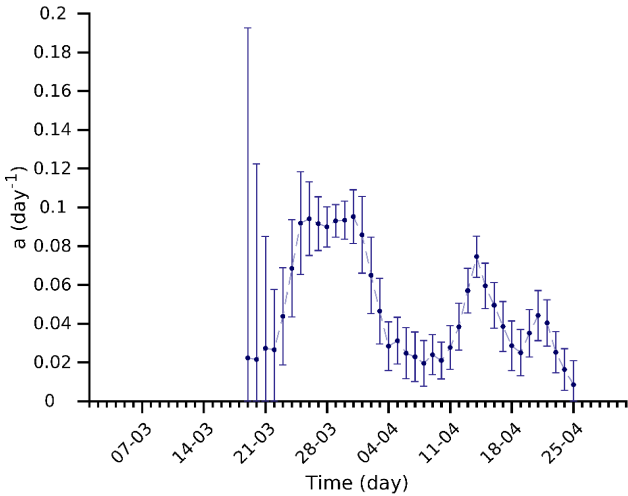
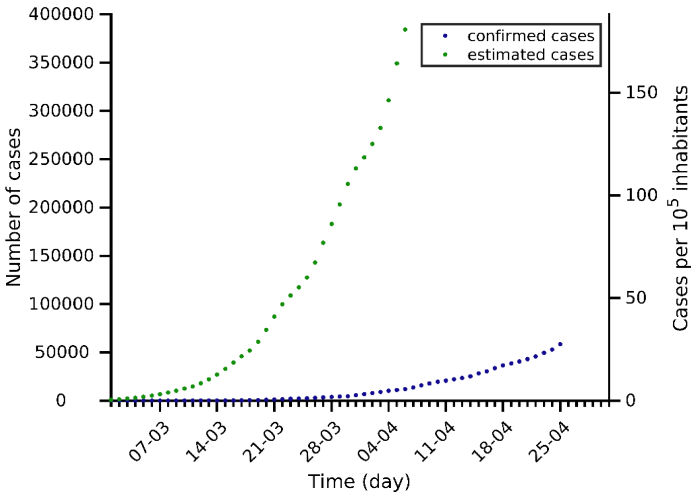
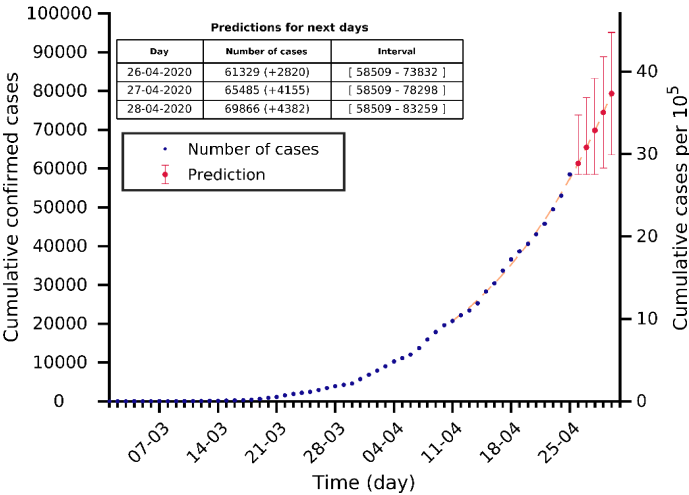


# Russia 25-04-2020. Population: 145.9M. Current cumulated incidence: 51/10<sup>5</sup>

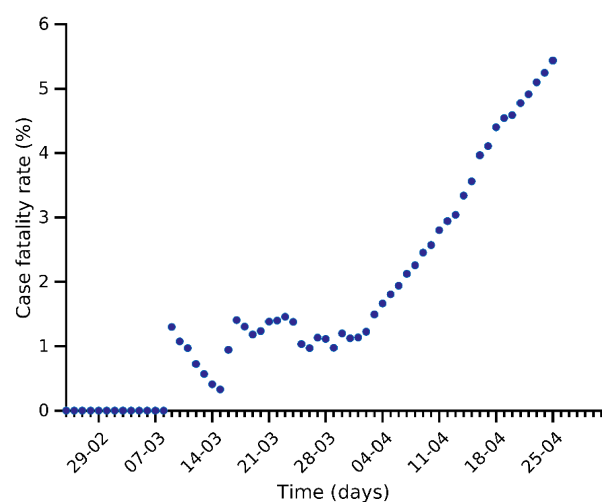
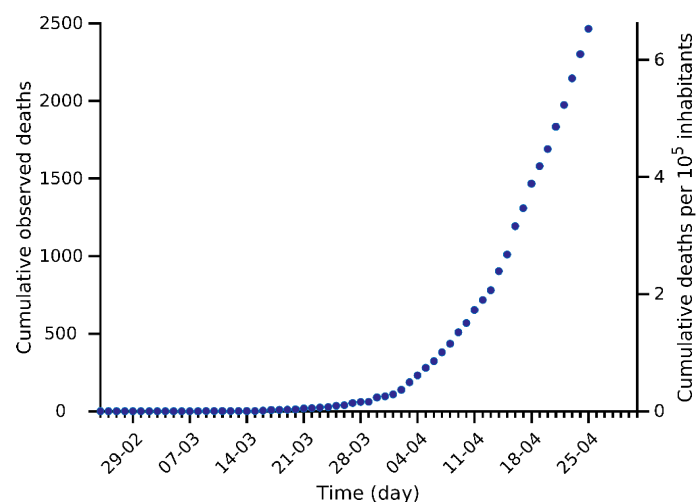
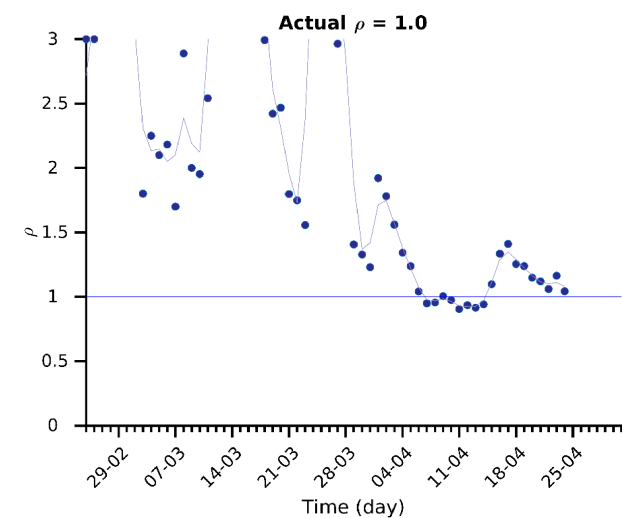
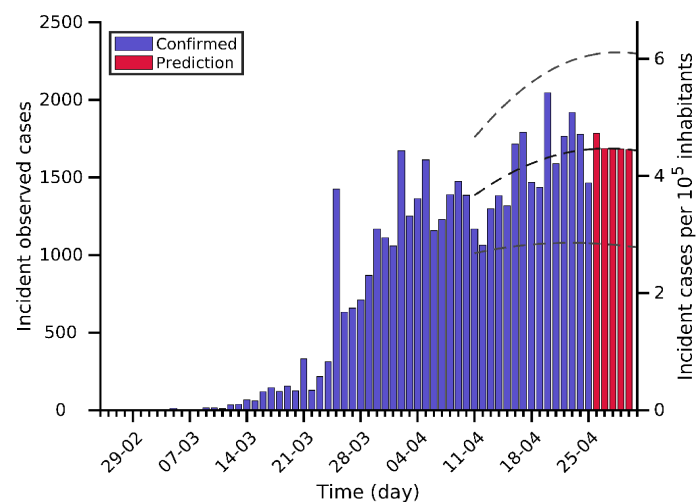
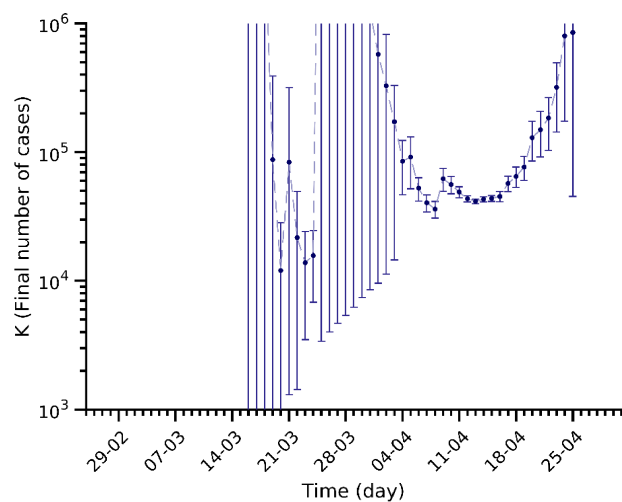
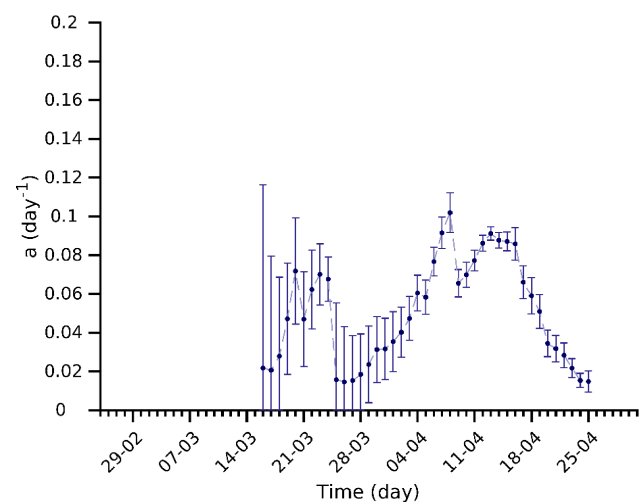
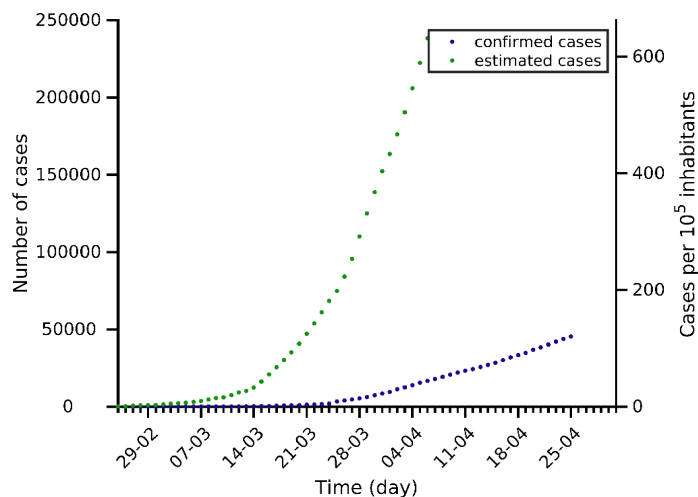
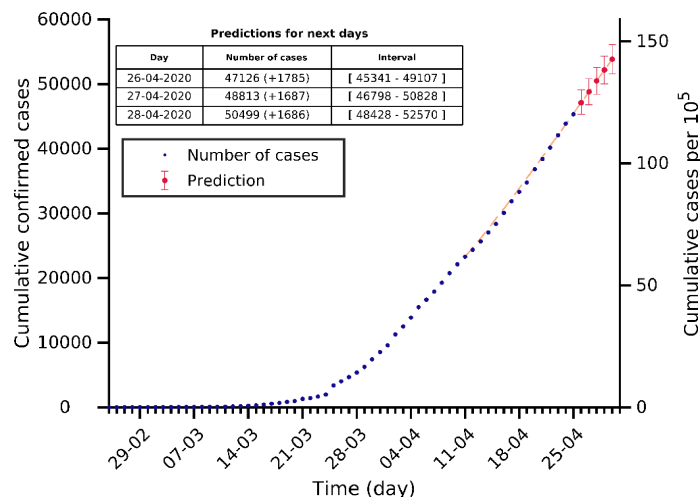




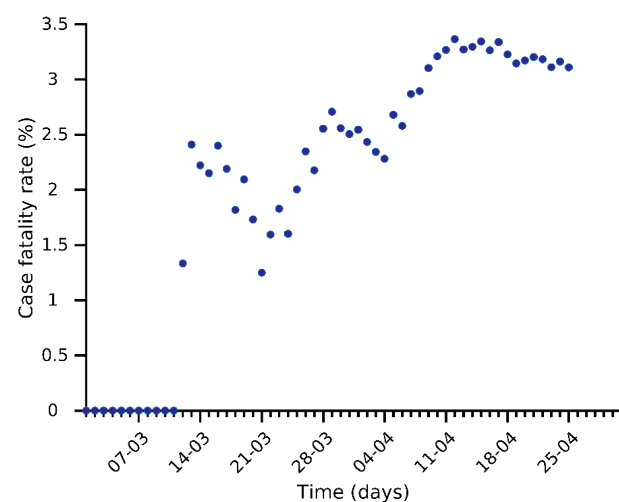
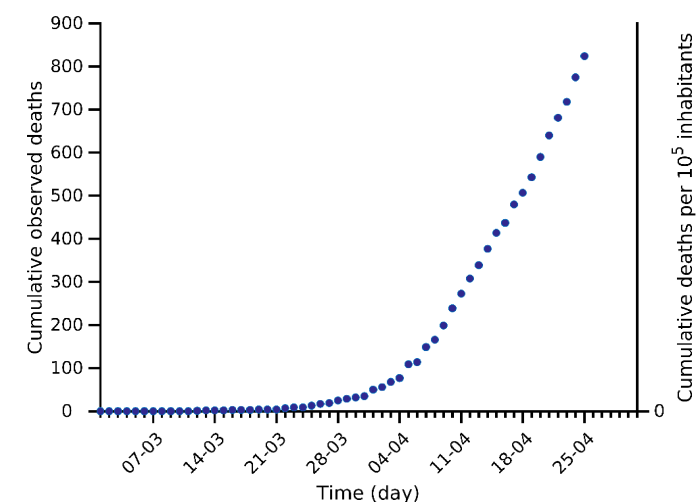
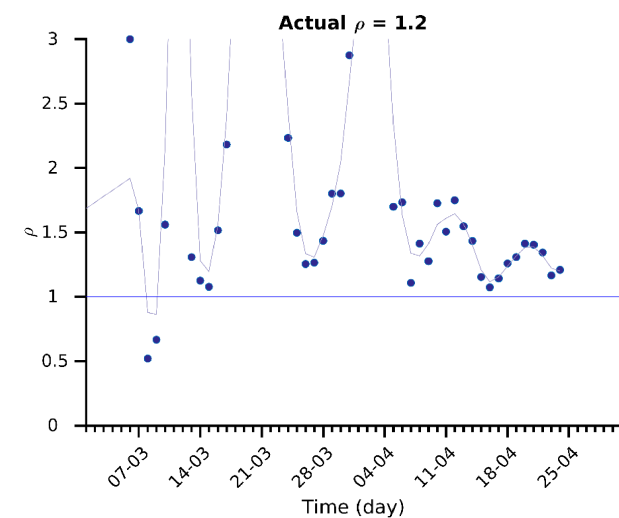
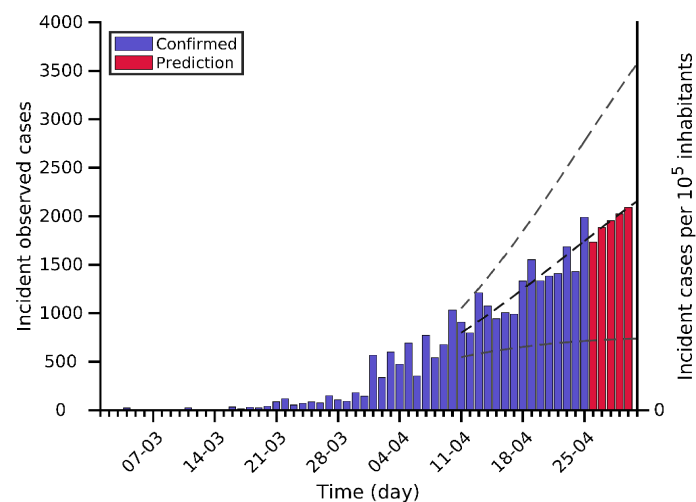
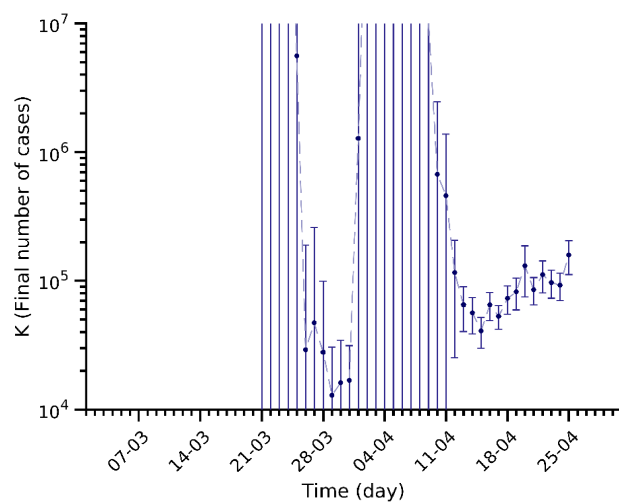
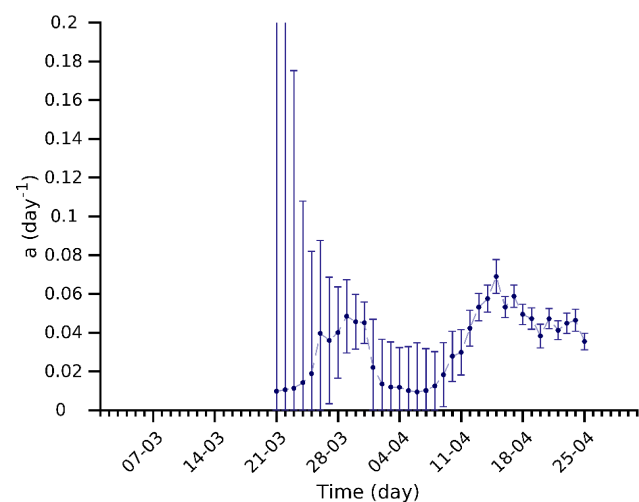
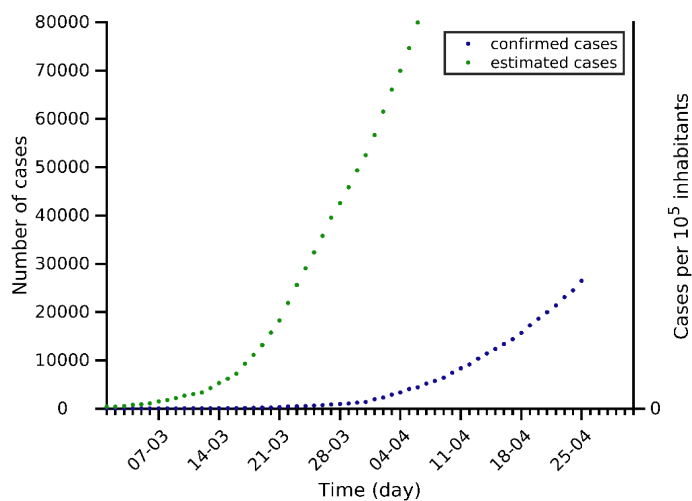
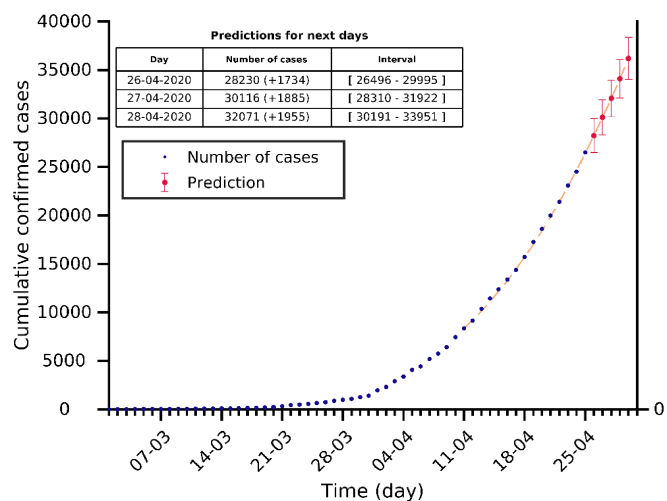
Brazil 25-04-2020. Population: 212.6M. Current cumulated incidence: 28/10<sup>5</sup>



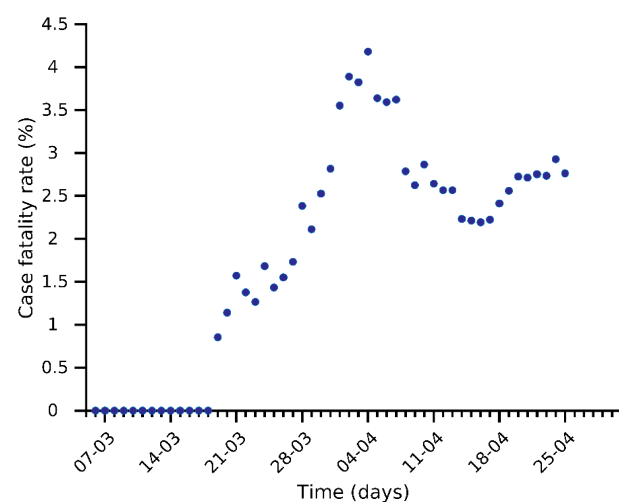
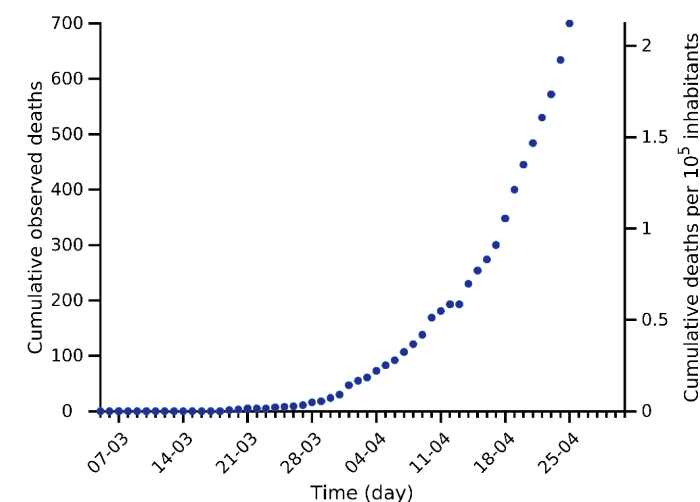
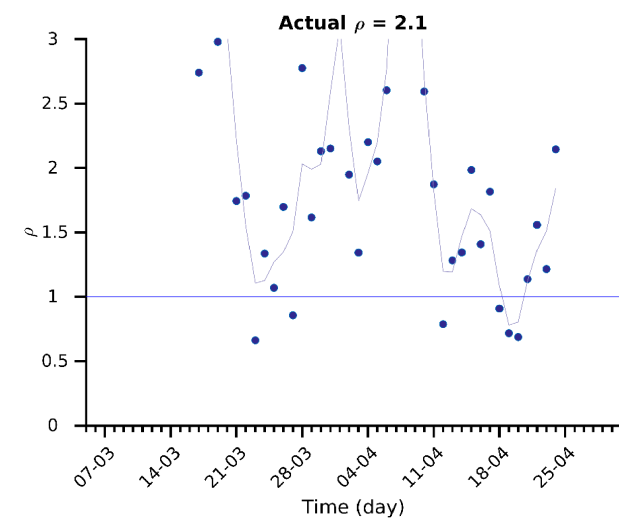
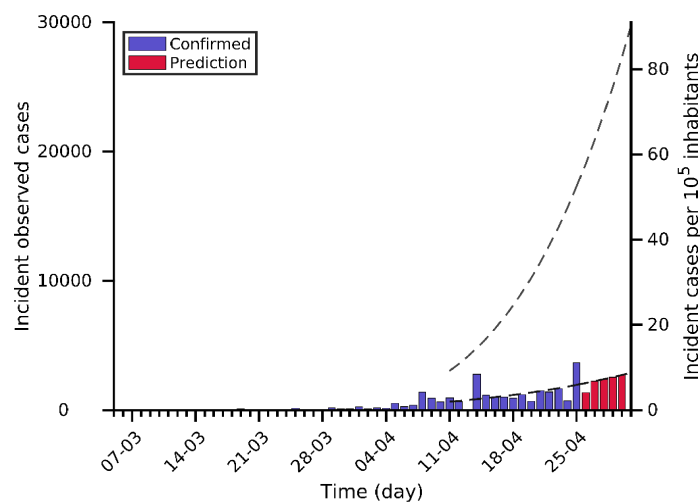
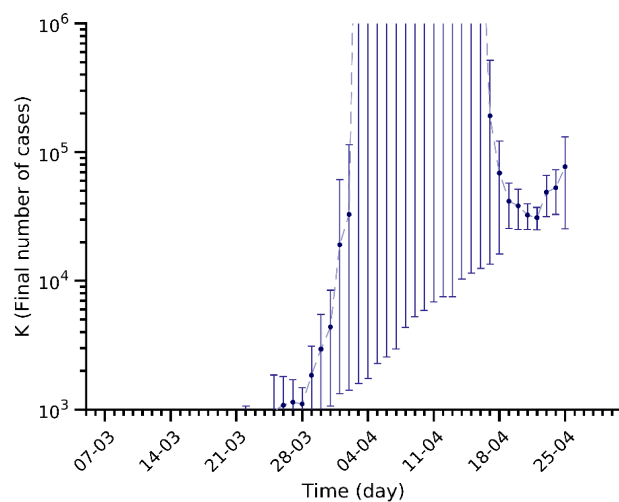
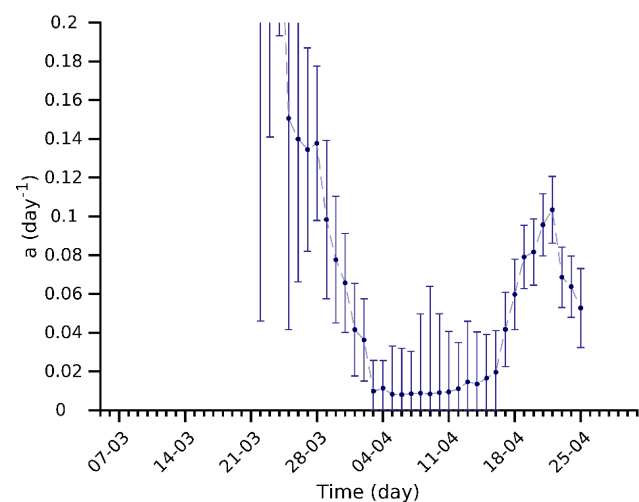
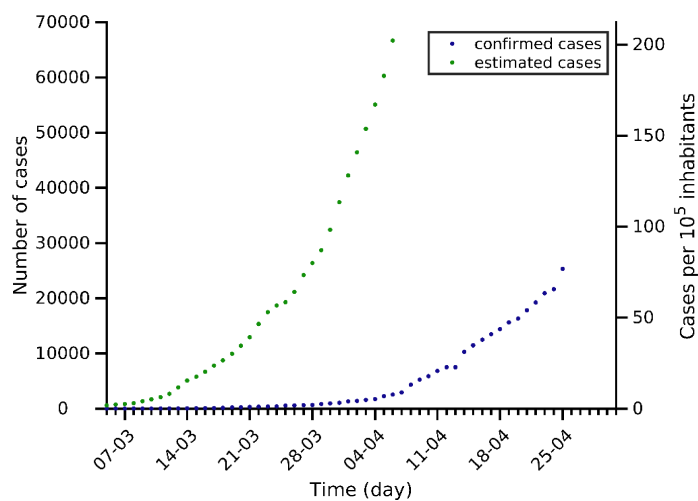
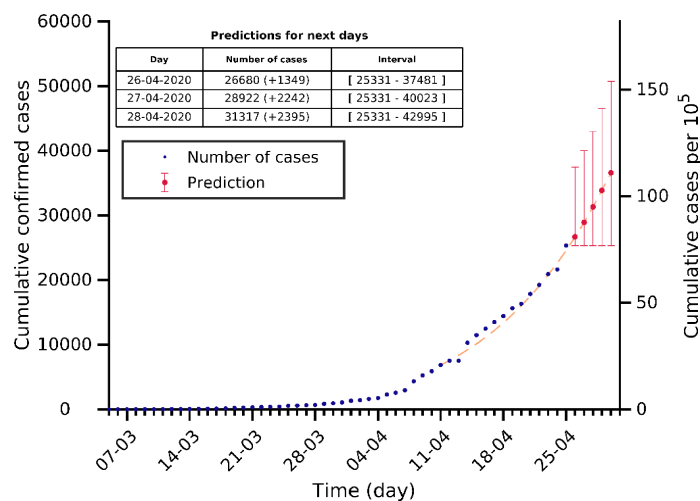
# Canada 25-04-2020. Population: 37.7M. Current cumulated incidence: 120/10<sup>5</sup>



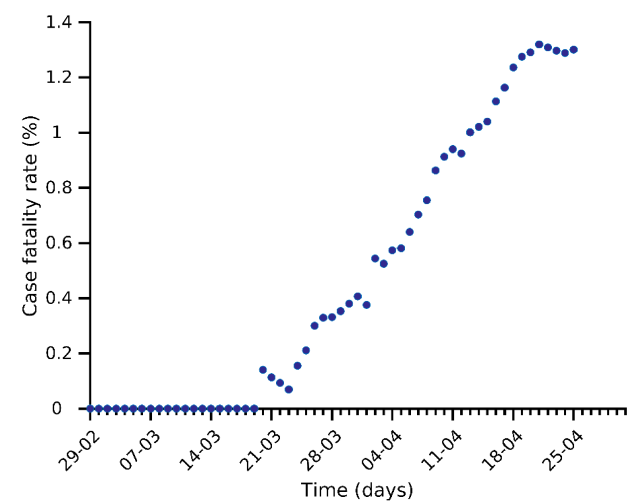
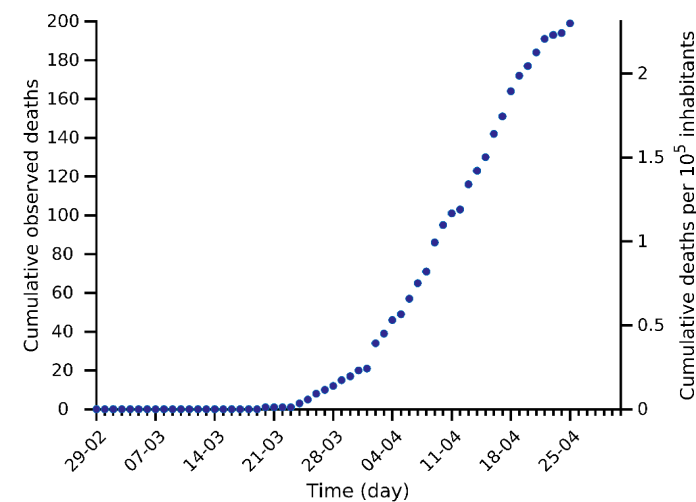
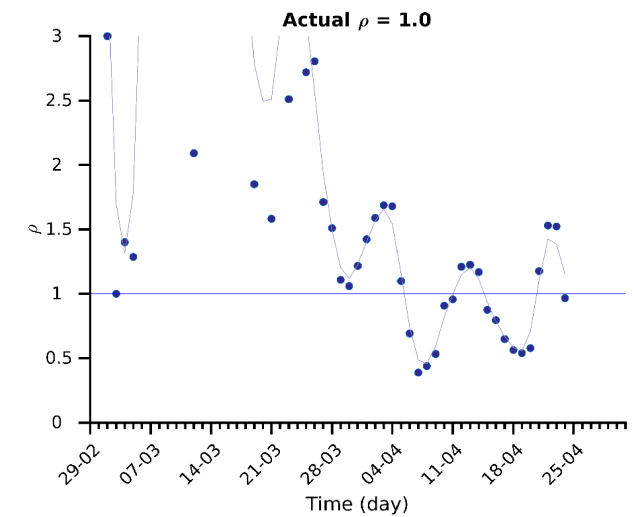
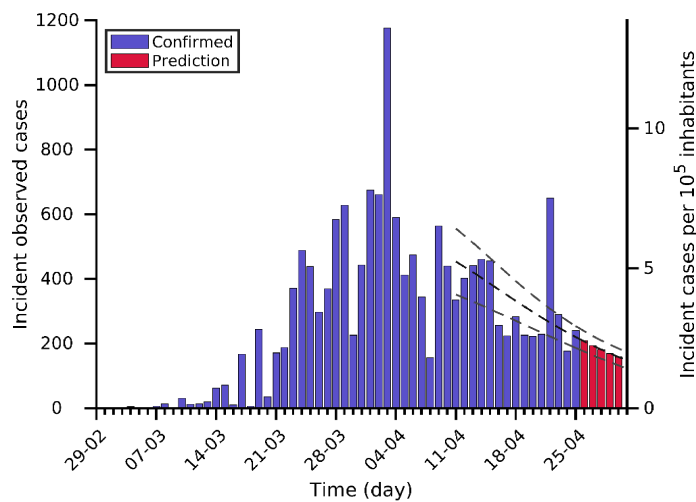
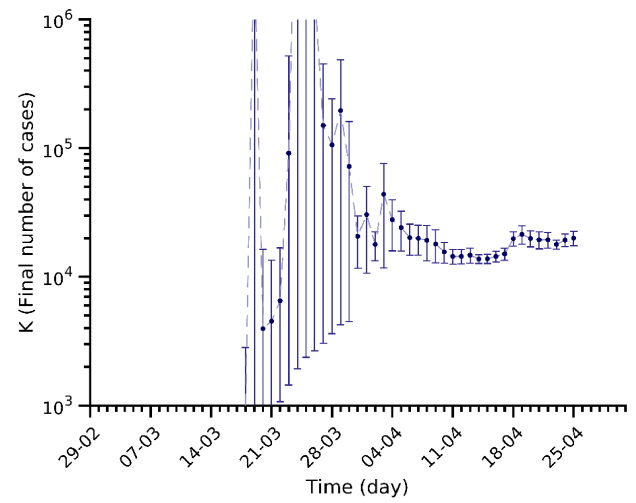
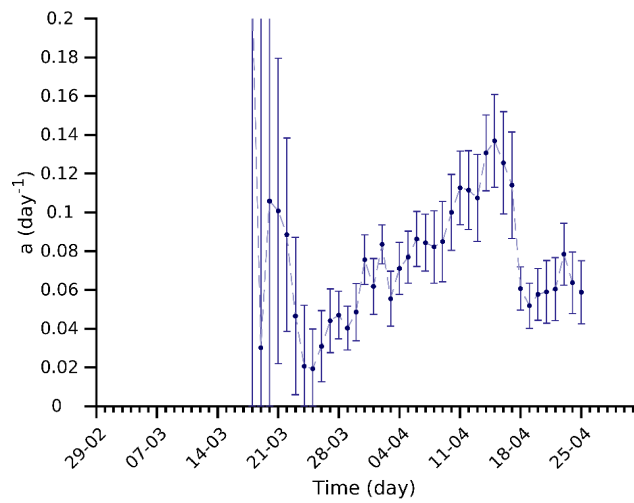
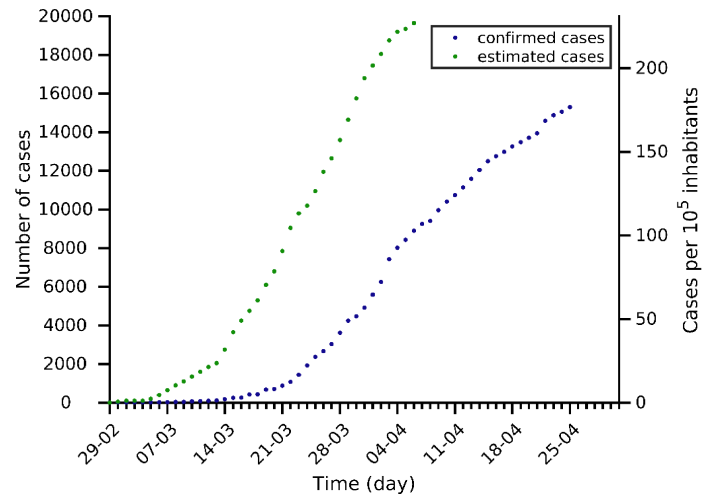
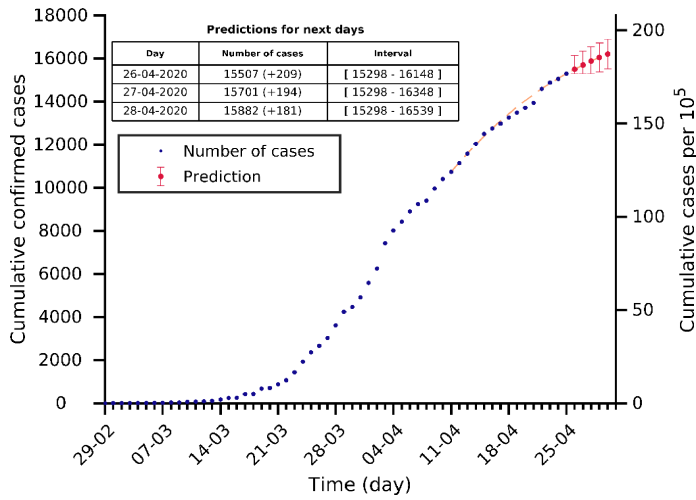
# India 25-04-2020. Population: 1353000.0M. Current cumulated incidence: 0/10<sup>5</sup>



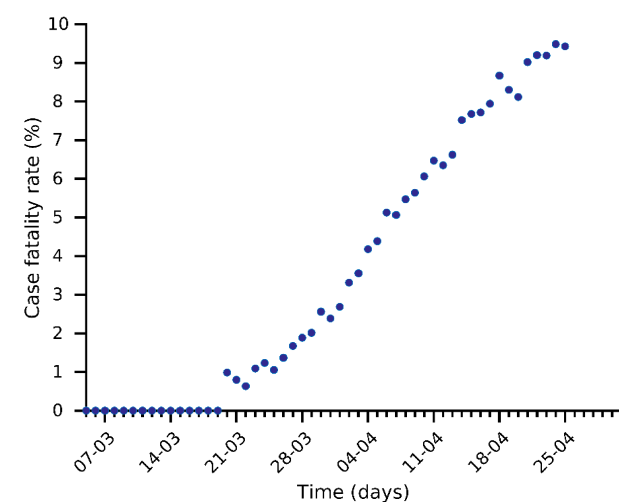
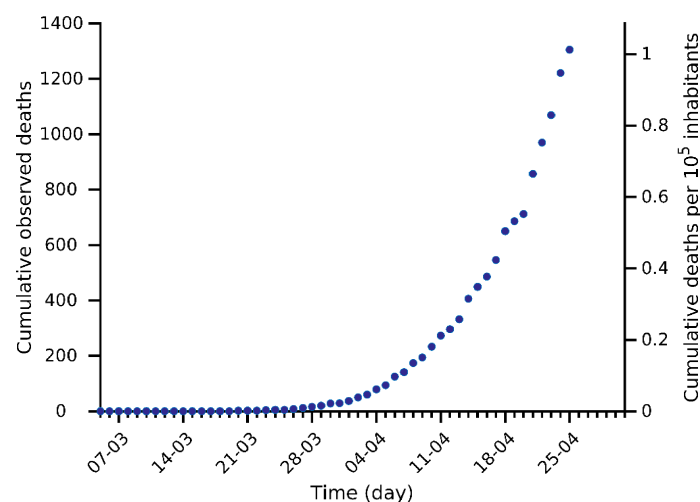
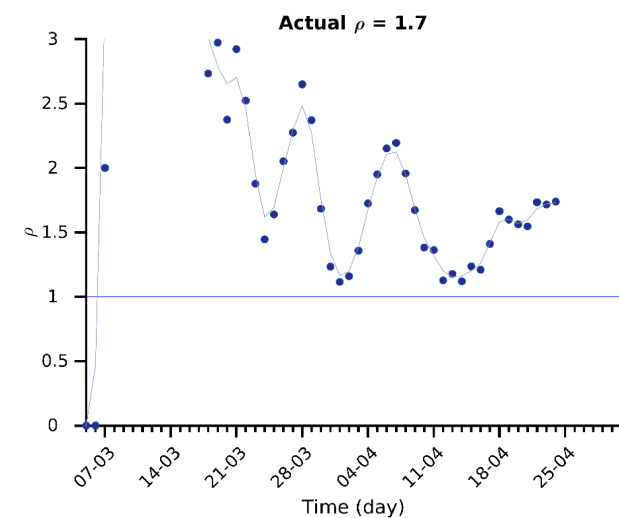
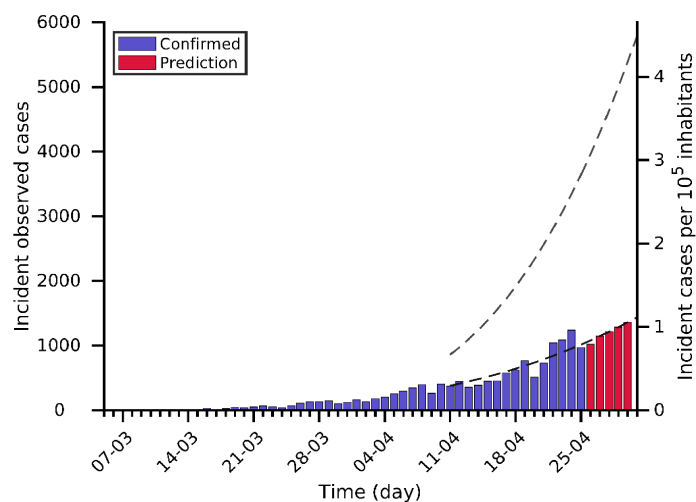
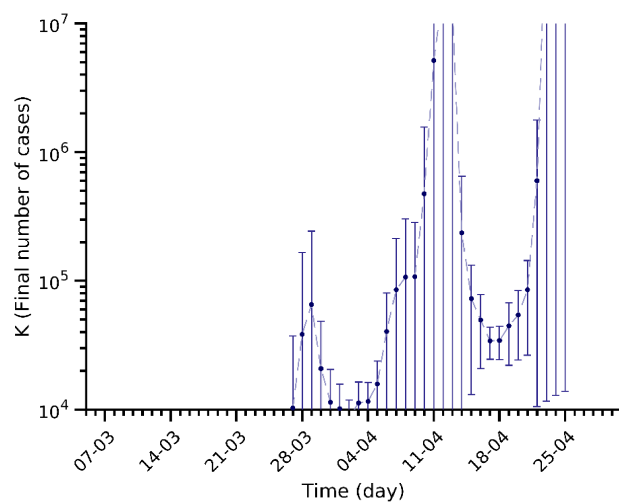
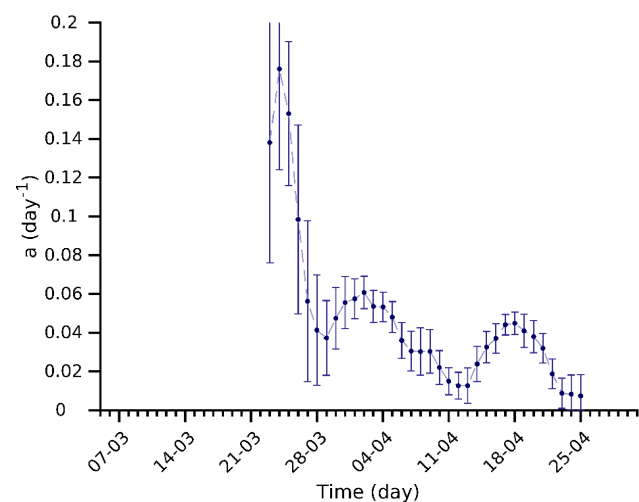
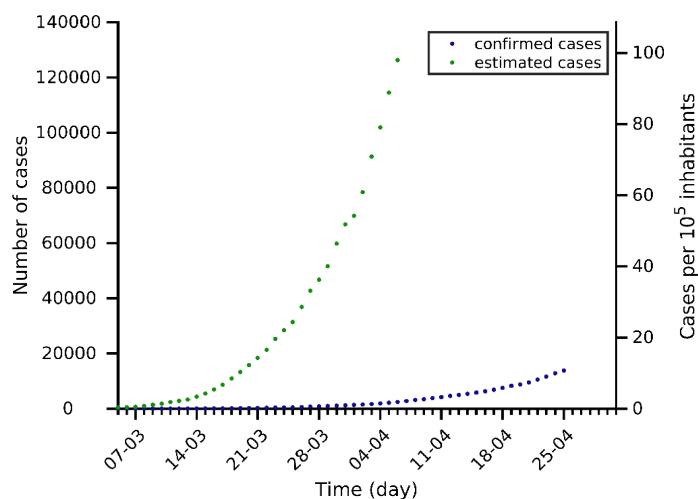
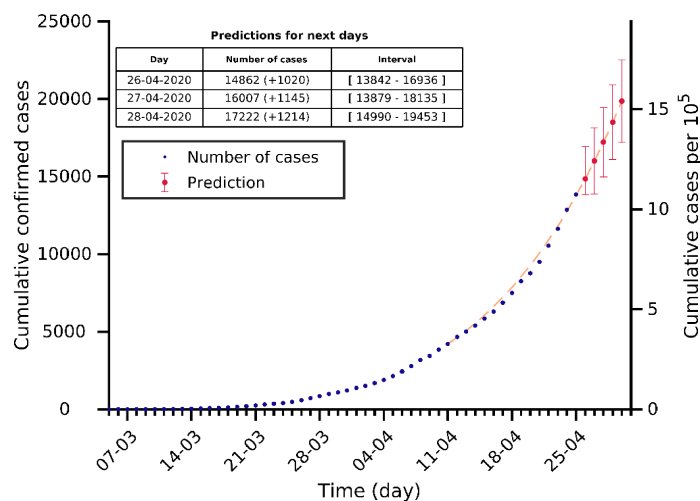
# Peru 25-04-2020. Population: 33.0M. Current cumulated incidence: 77/10<sup>5</sup>



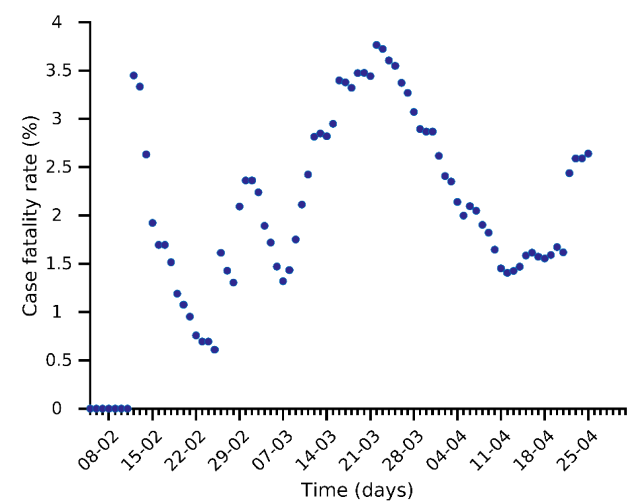
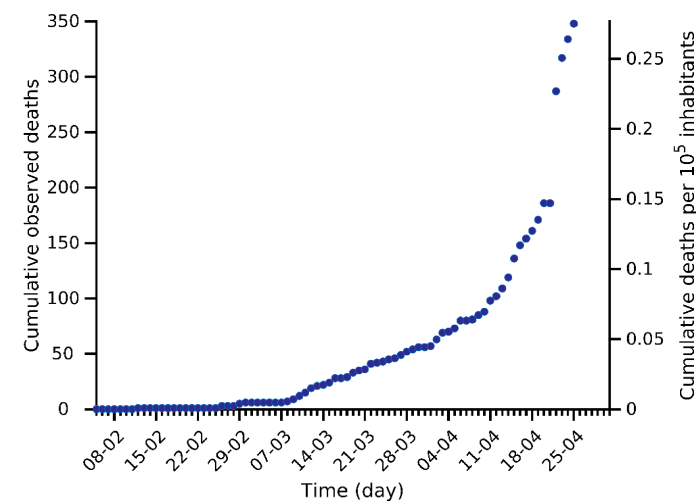
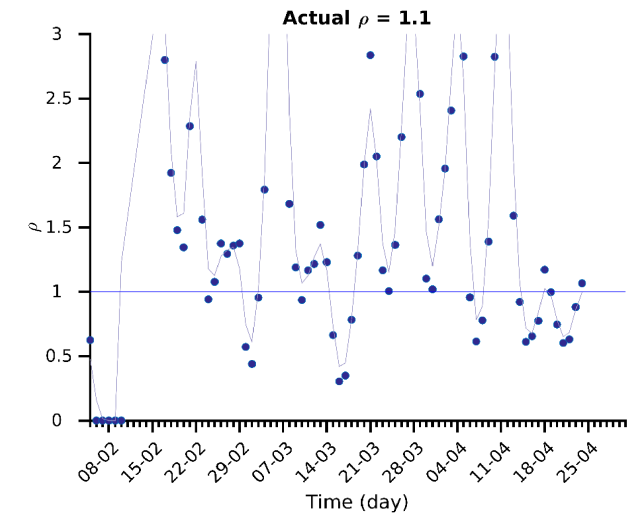
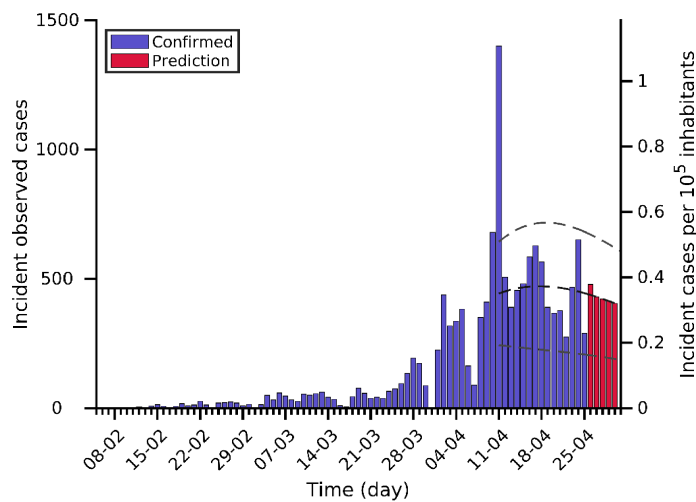
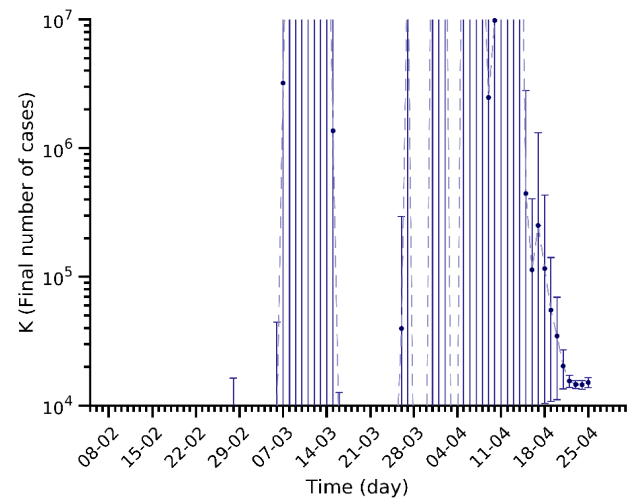
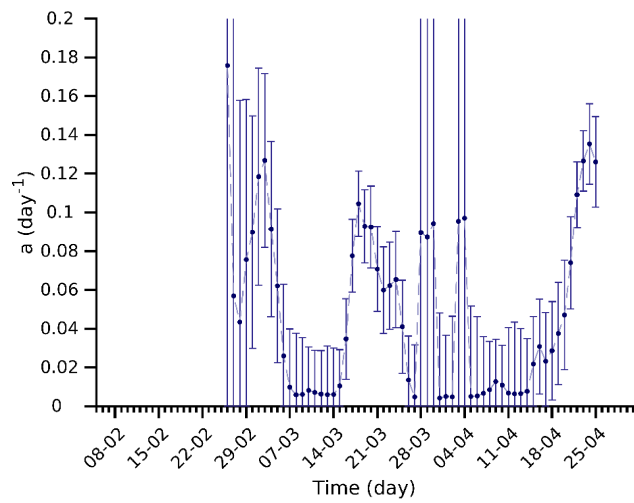
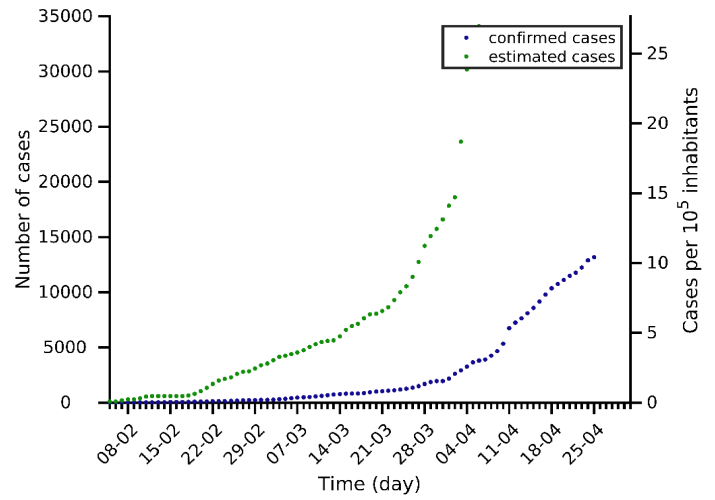
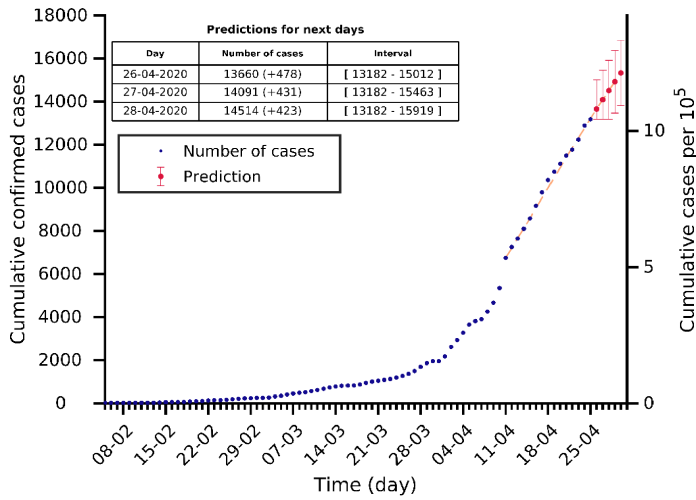
# Israel 25-04-2020. Population: 8.7M. Current cumulated incidence: 177/10<sup>5</sup>



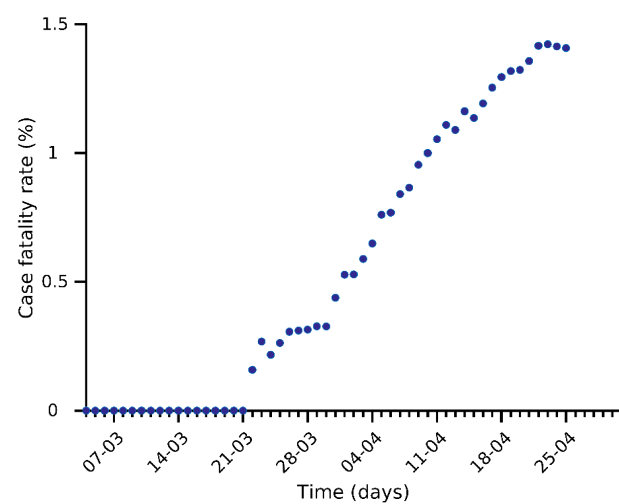
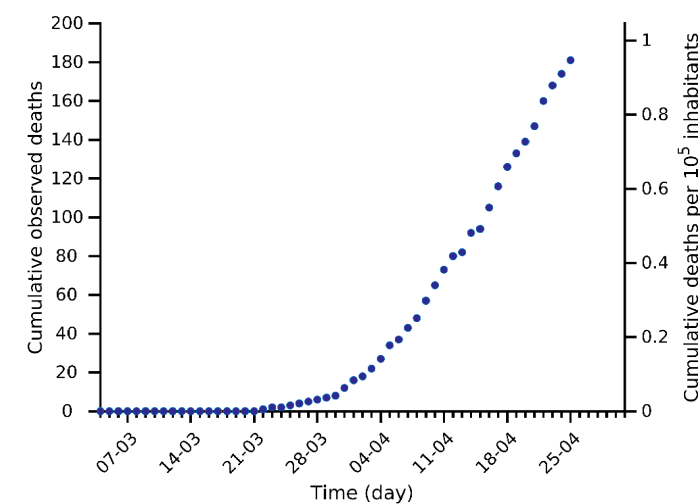
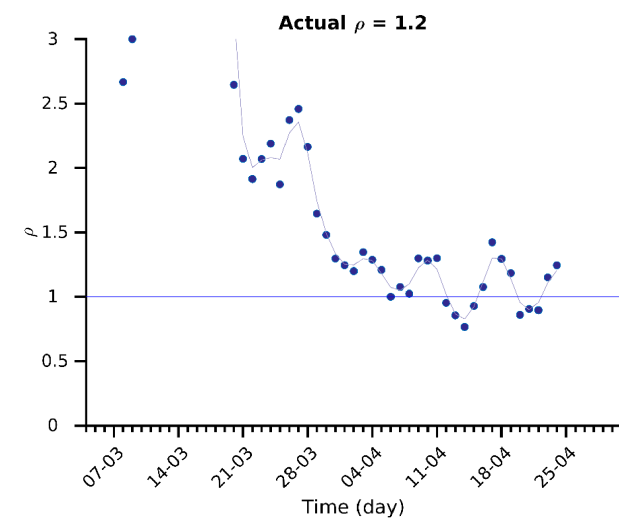
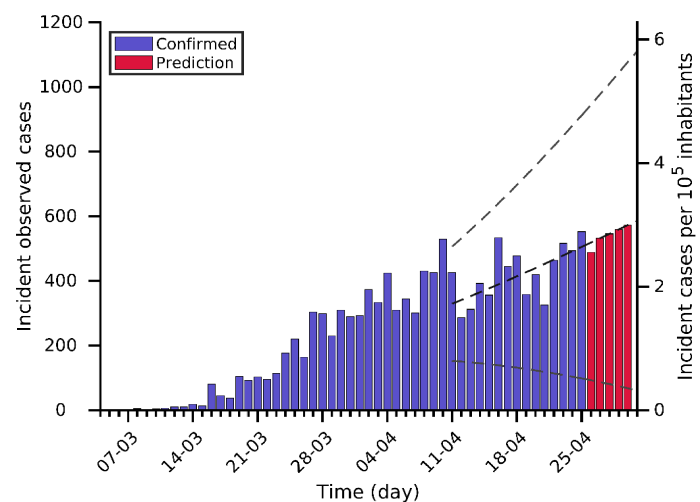
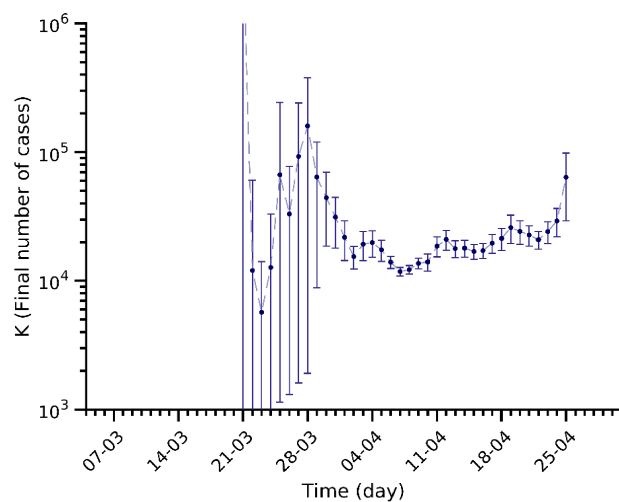
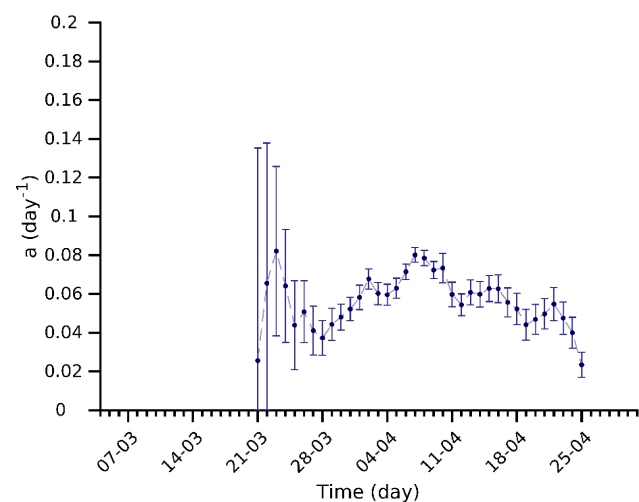
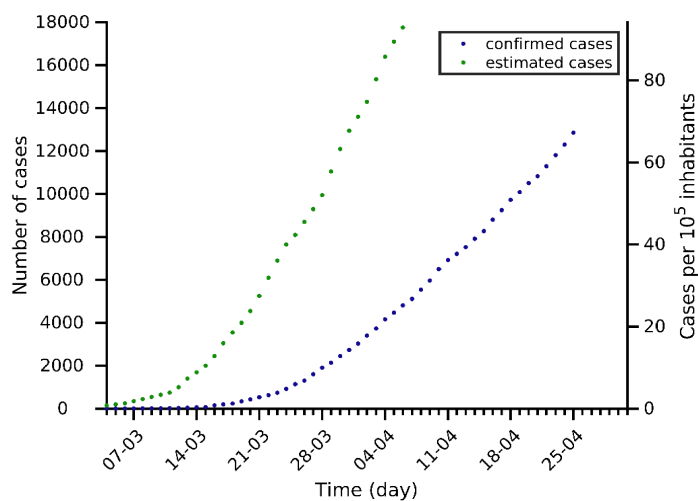
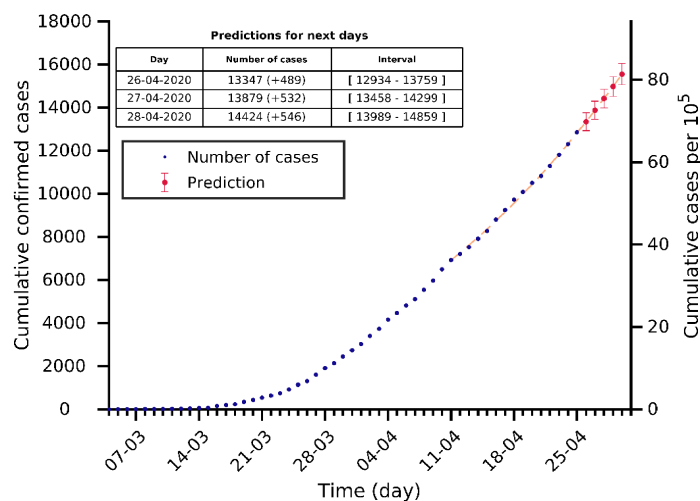
# Mexico 25-04-2020. Population: 128.9M. Current cumulated incidence: 11/10<sup>5</sup>



# Japan 25-04-2020. Population: 126.5M. Current cumulated incidence: 10/10<sup>5</sup>

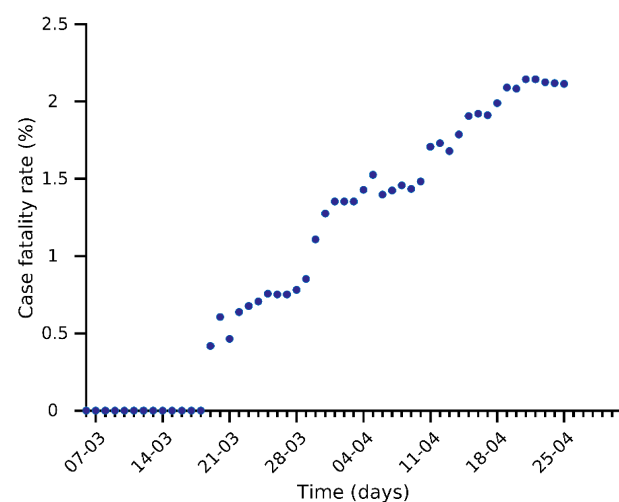
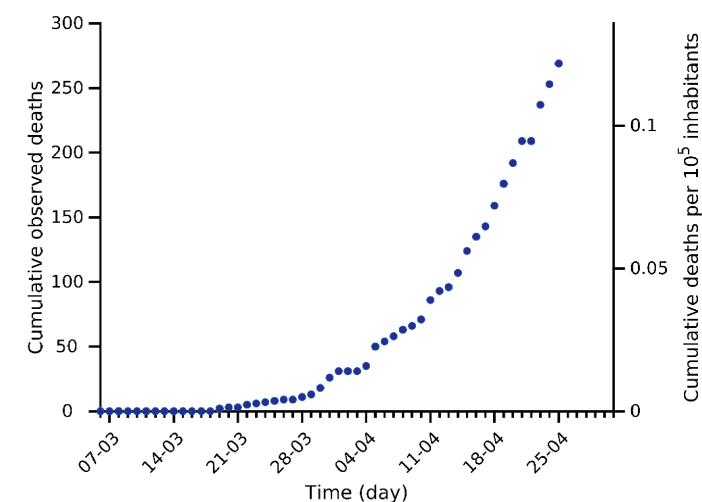
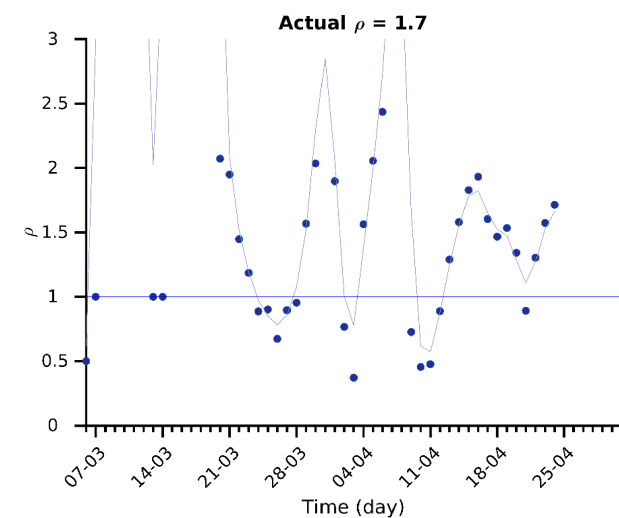
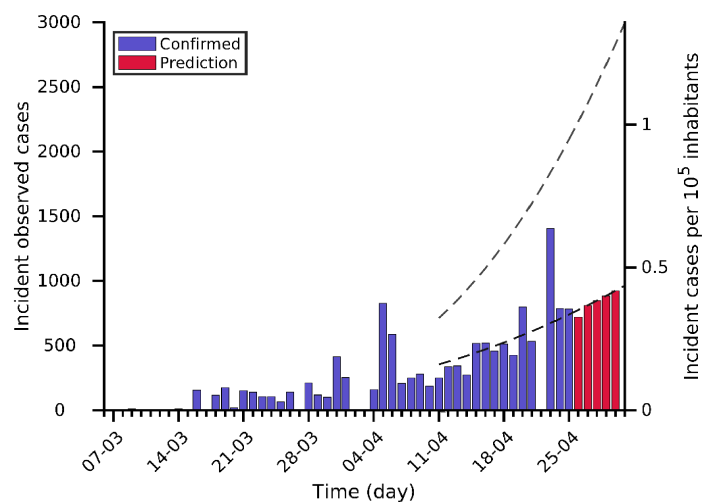
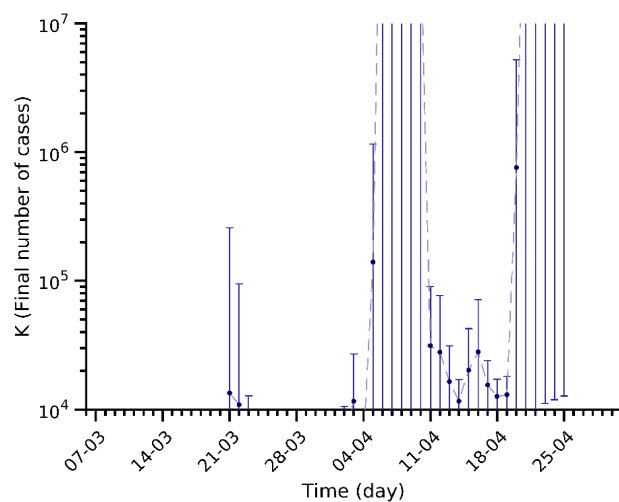
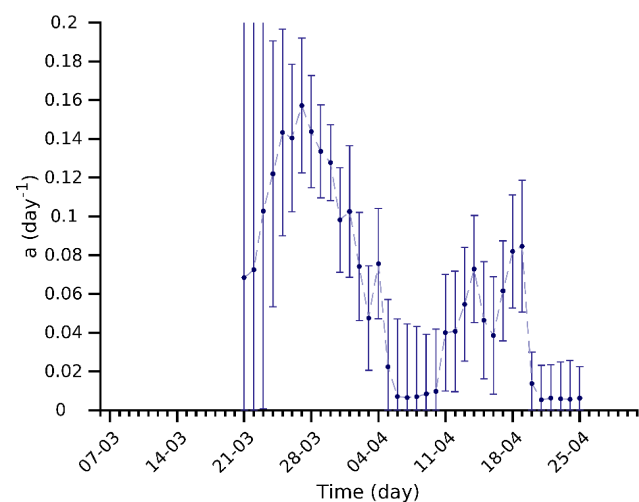
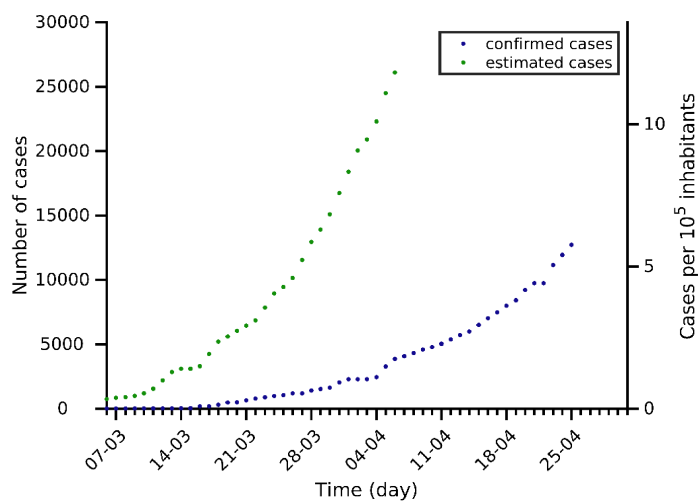
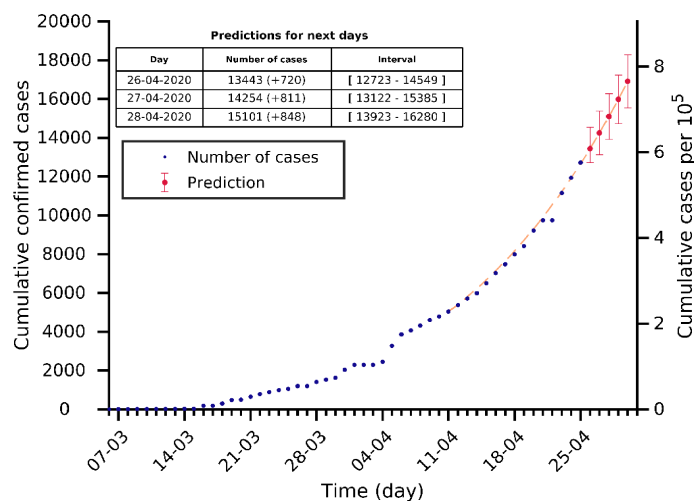


# Chile 25-04-2020. Population: 19.1M. Current cumulated incidence: 67/10<sup>5</sup>

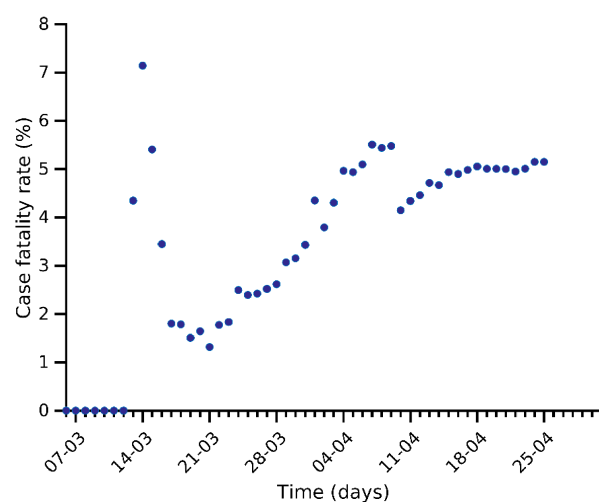
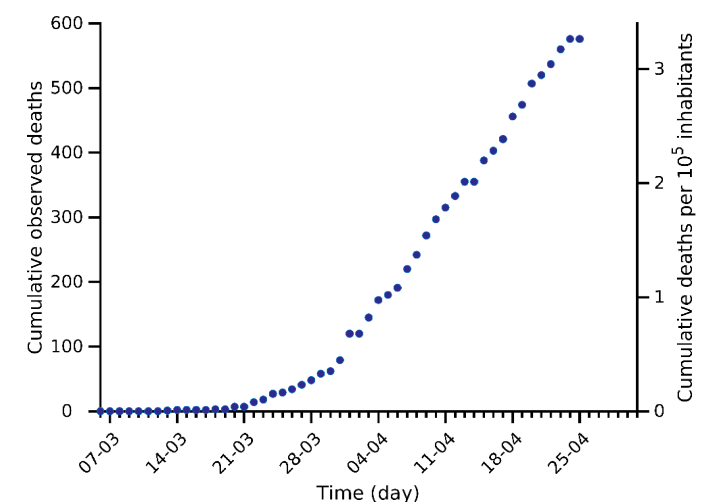
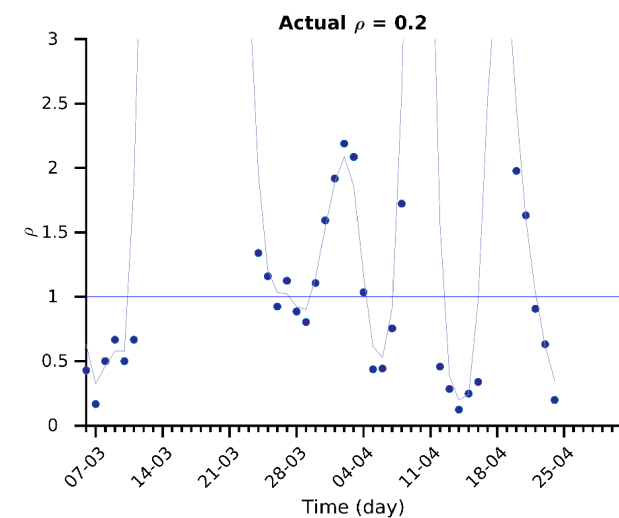
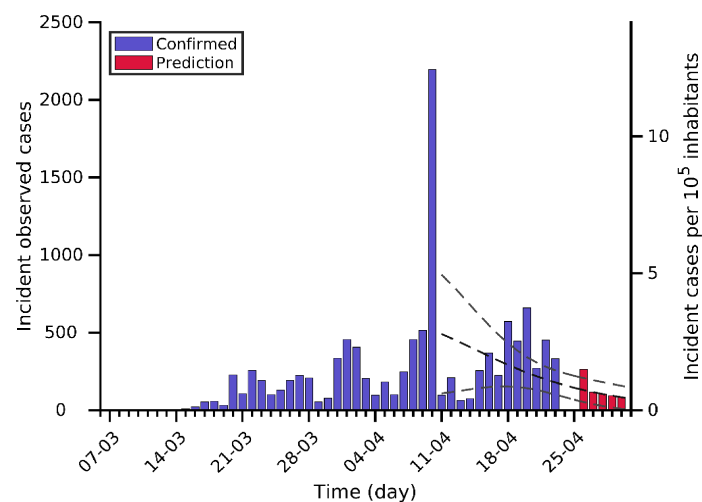
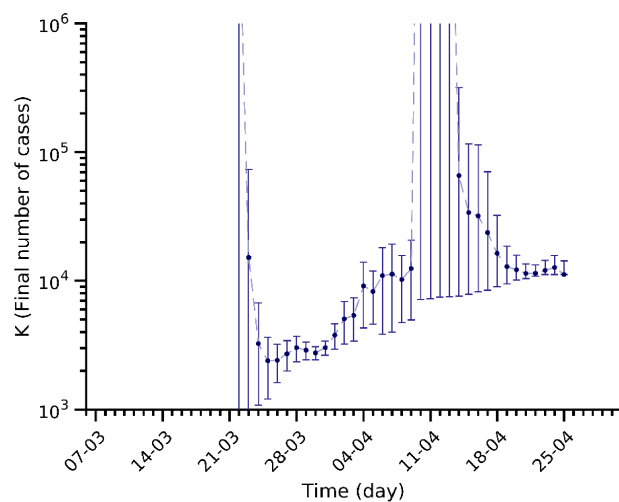
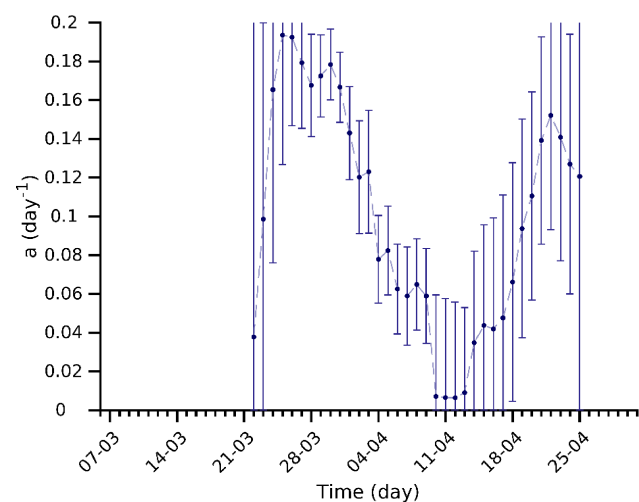
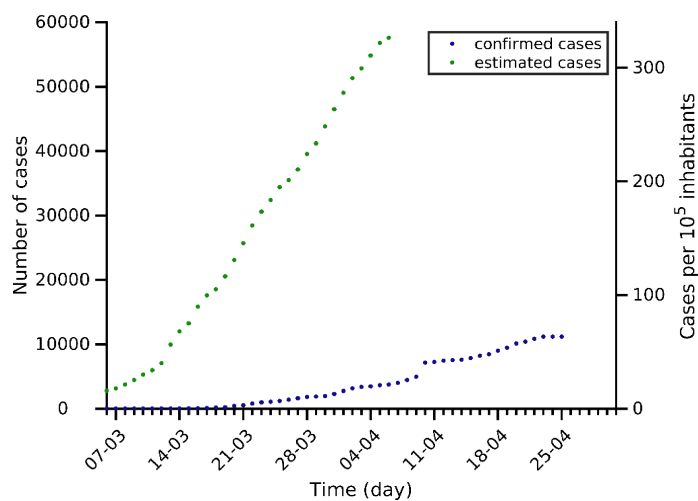
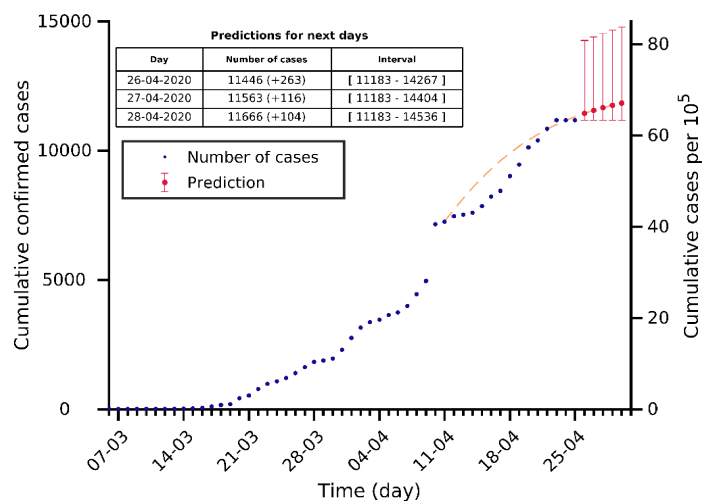




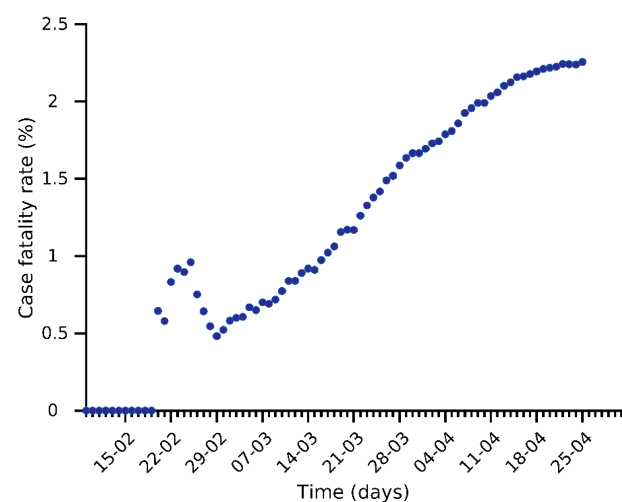
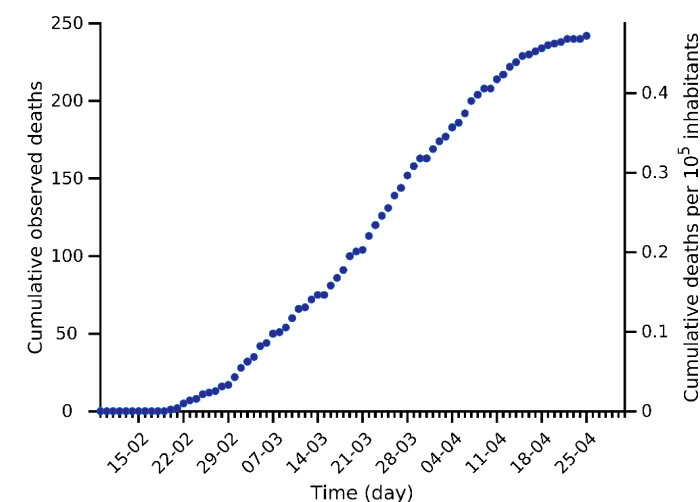
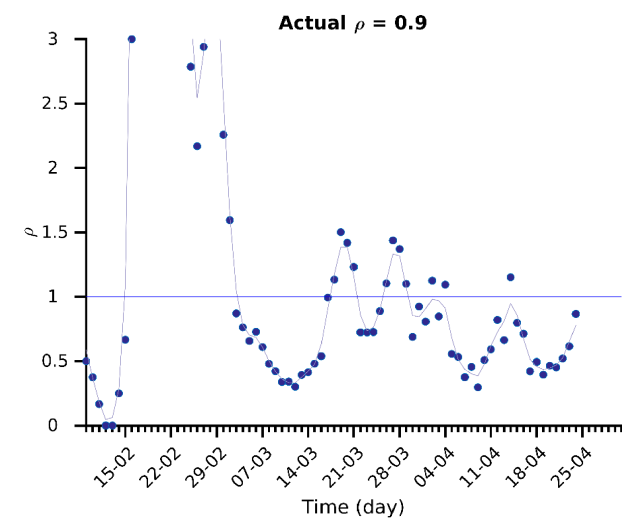
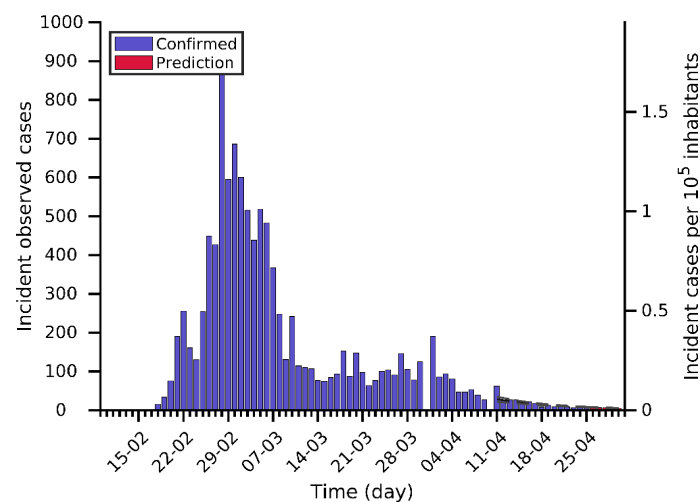
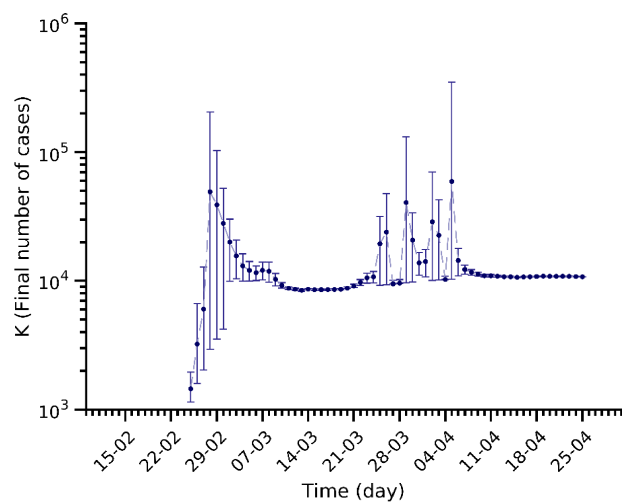
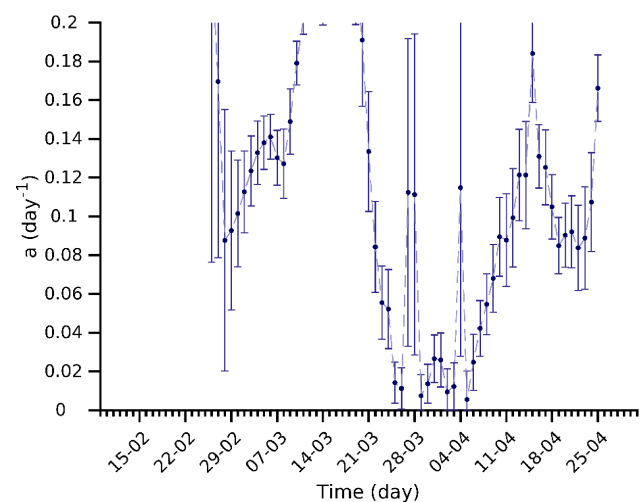
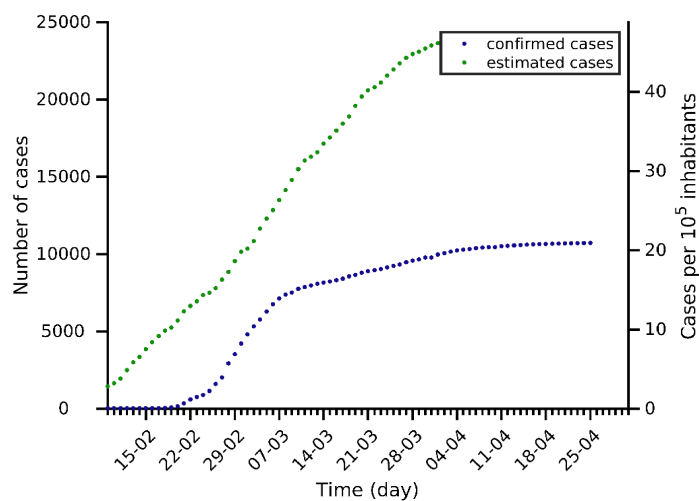
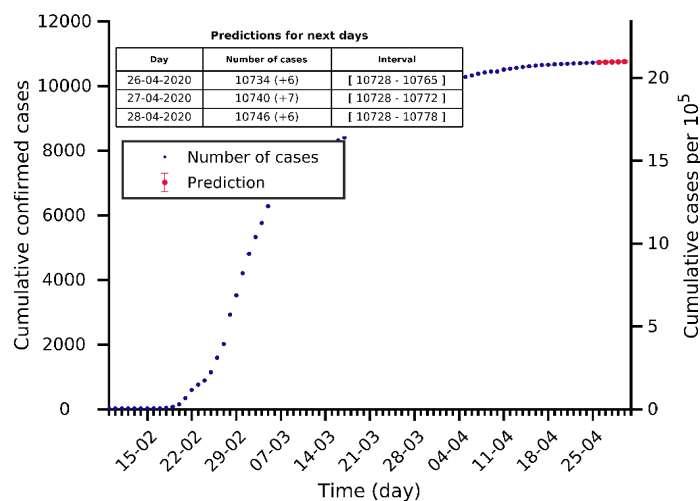
# Pakistan 25-04-2020. Population: 220.9M. Current cumulated incidence: $6/10^5$



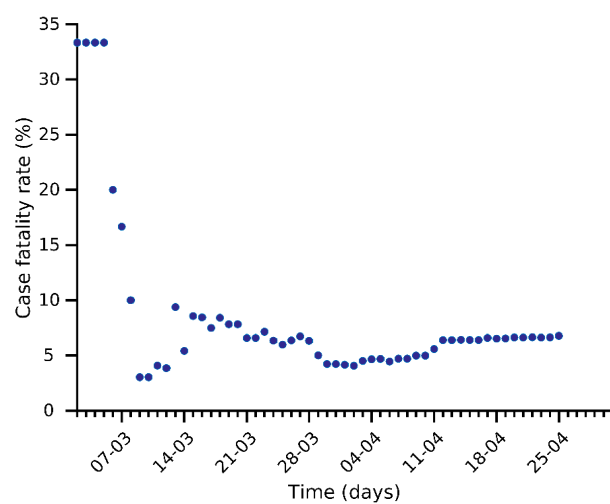
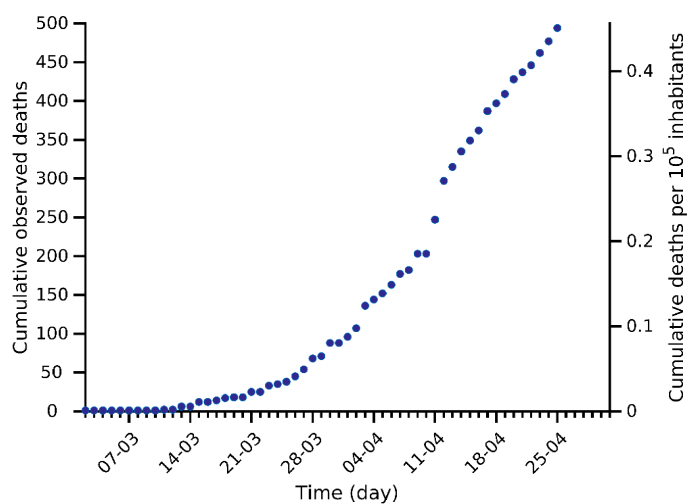
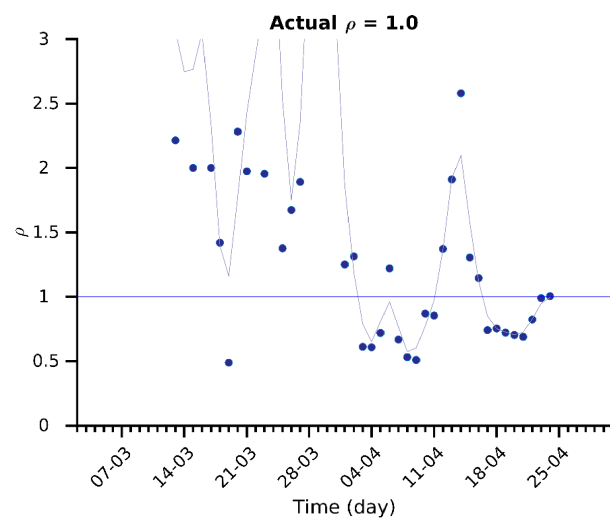
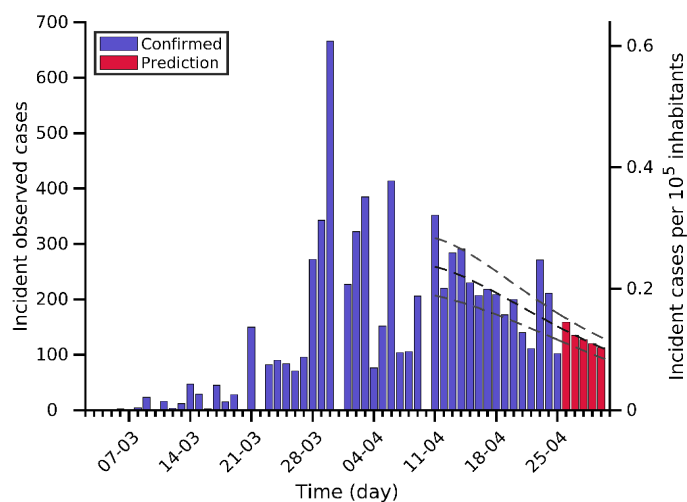
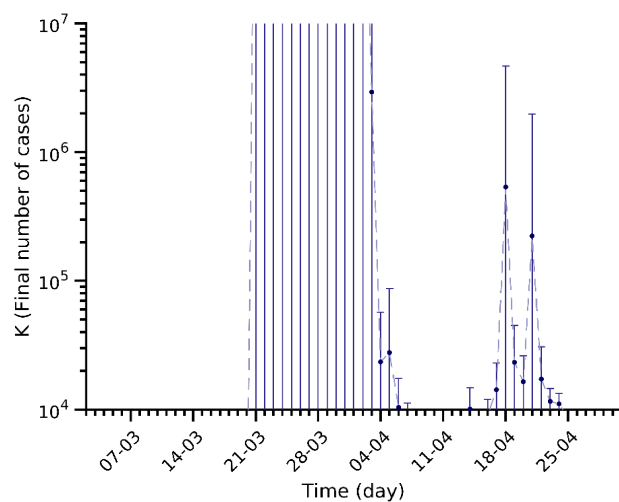
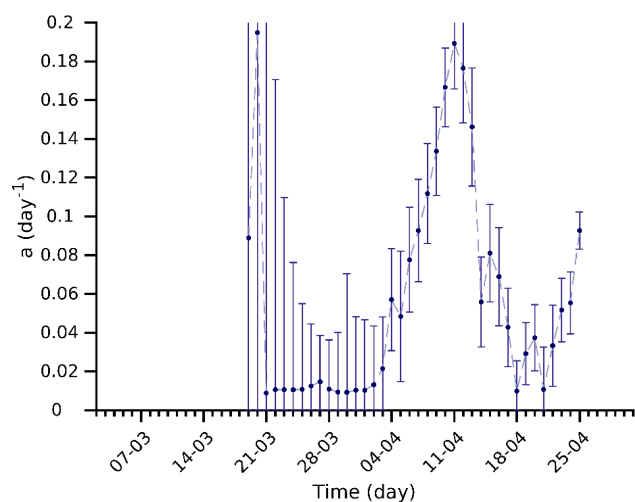
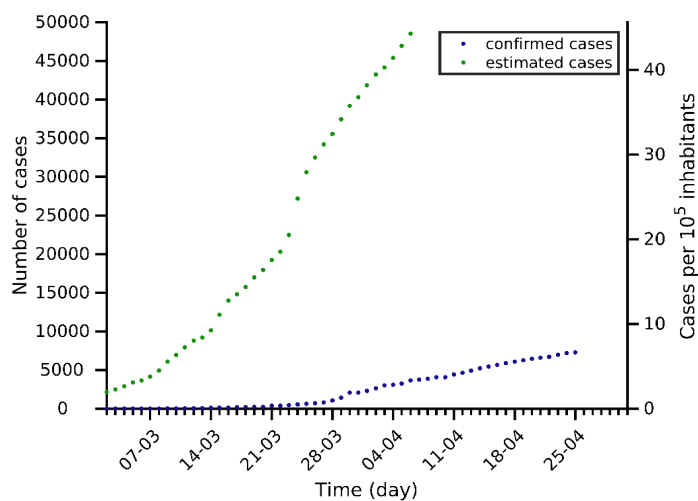
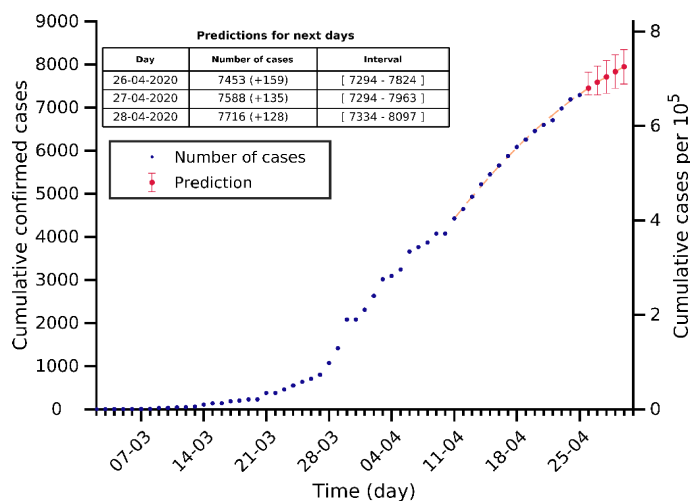
# Ecuador 25-04-2020. Population: 17.6M. Current cumulated incidence: 63/10<sup>5</sup>



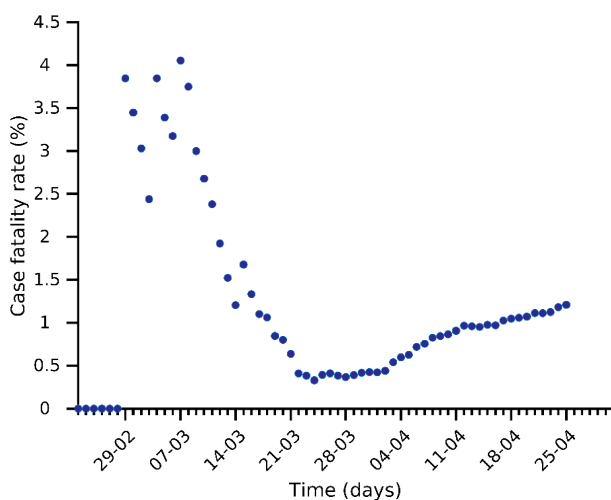
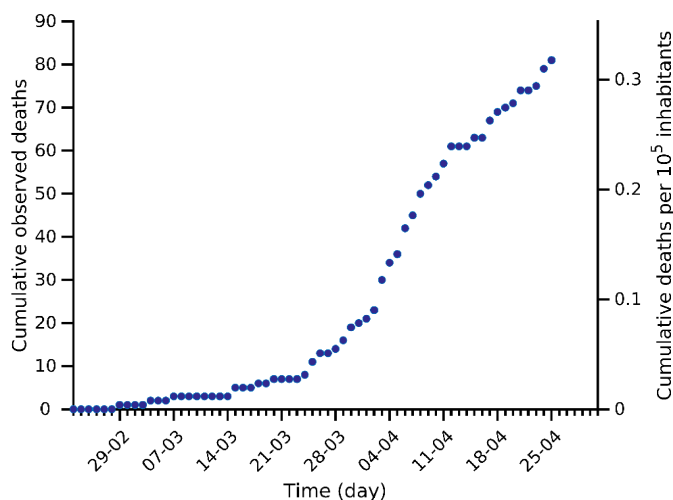
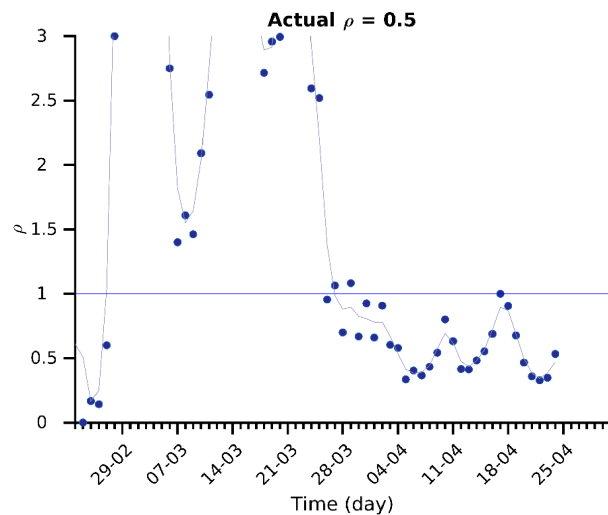
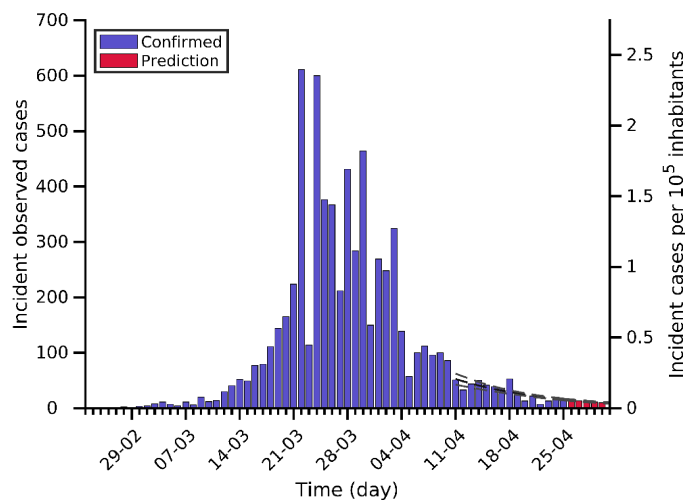
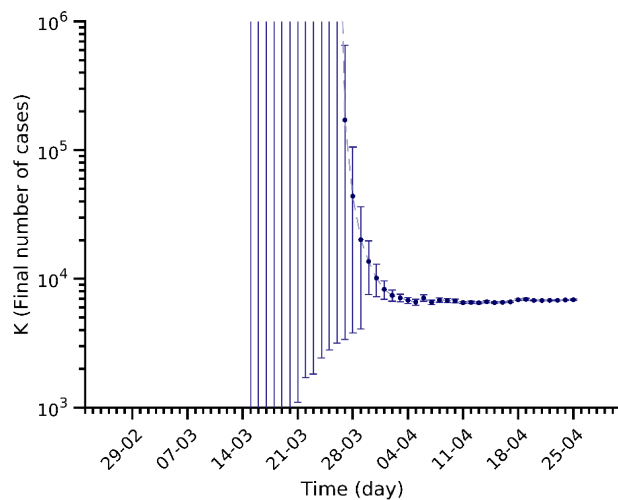
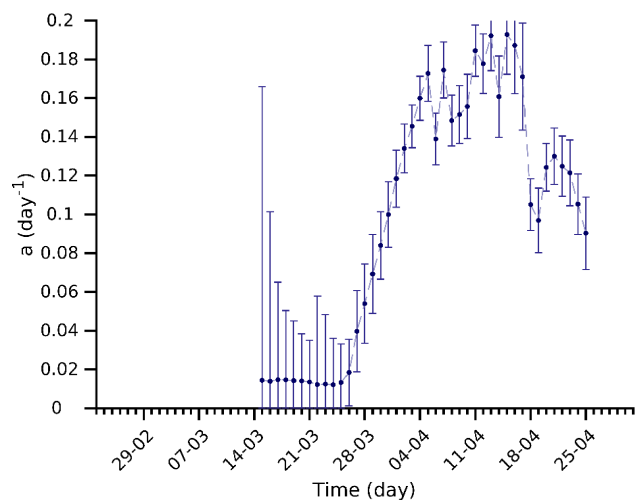
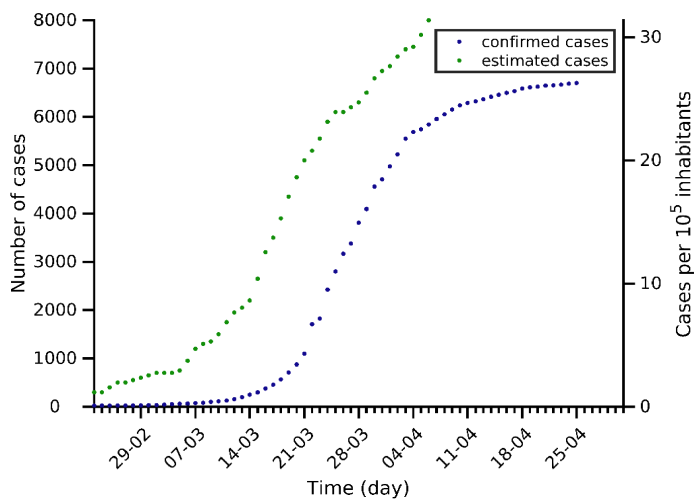
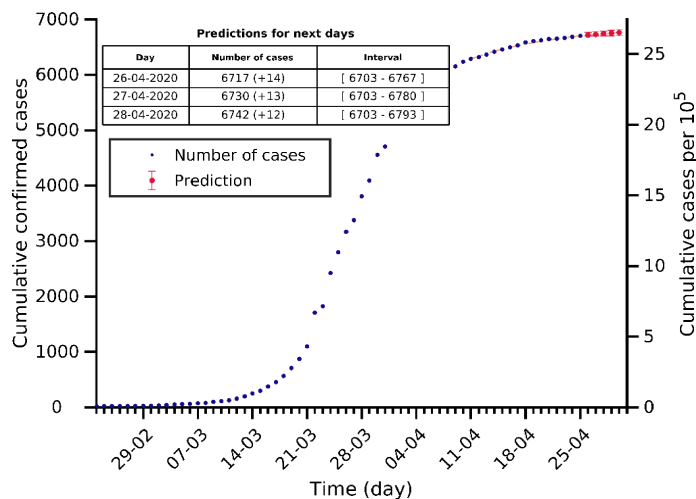
# South Korea 25-04-2020. Population: 51.3M. Current cumulated incidence: 21/10<sup>5</sup>



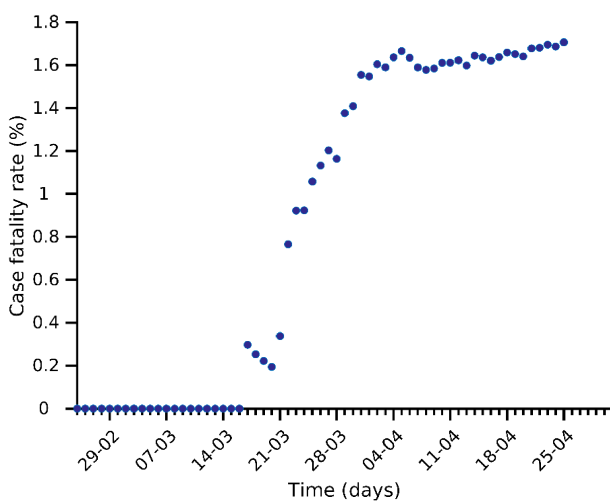
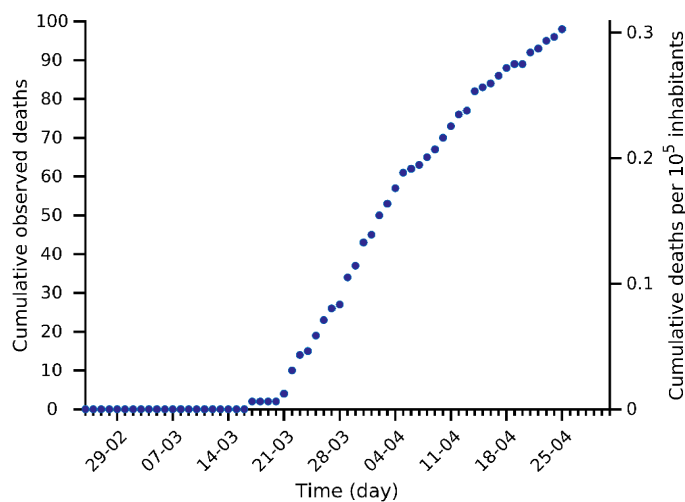
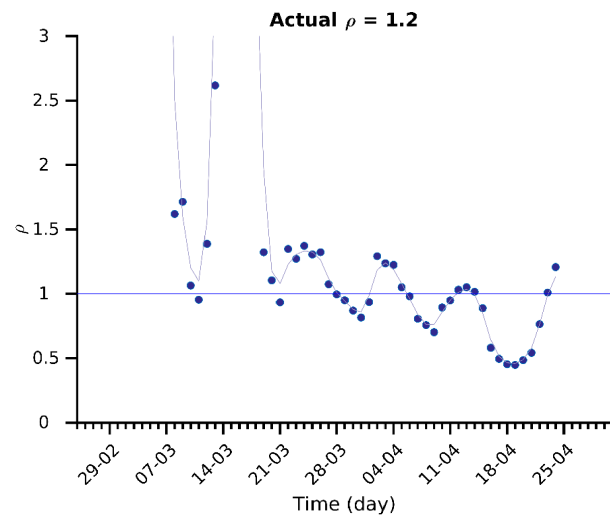
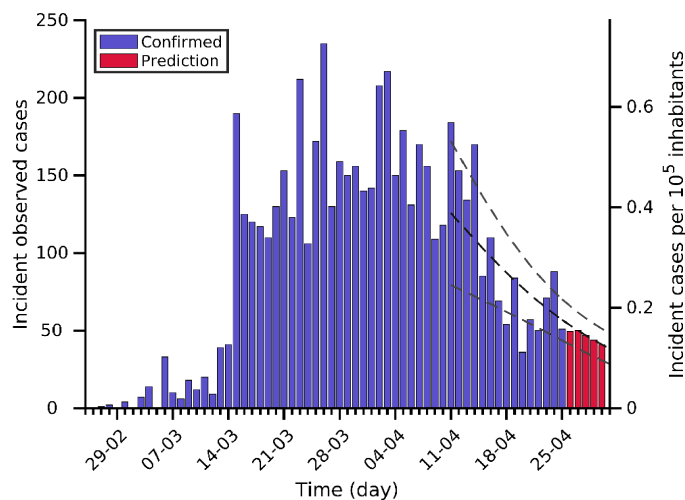
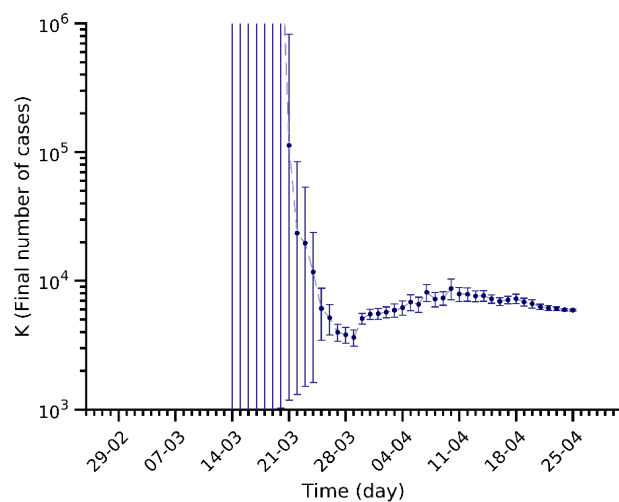
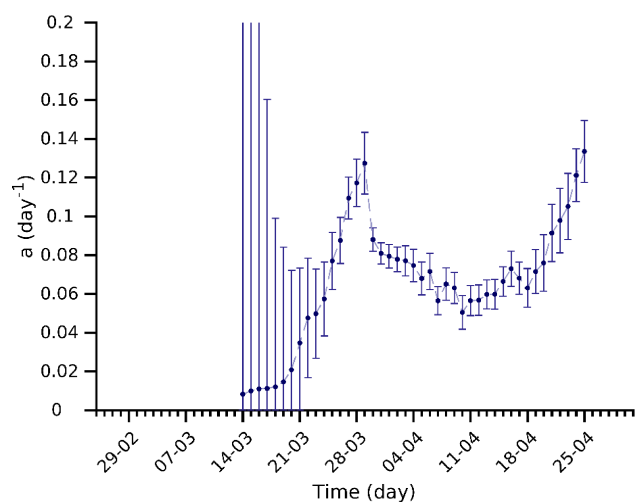
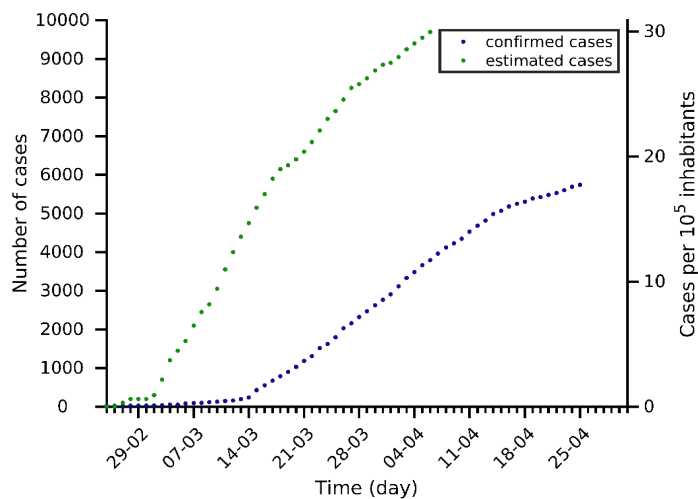
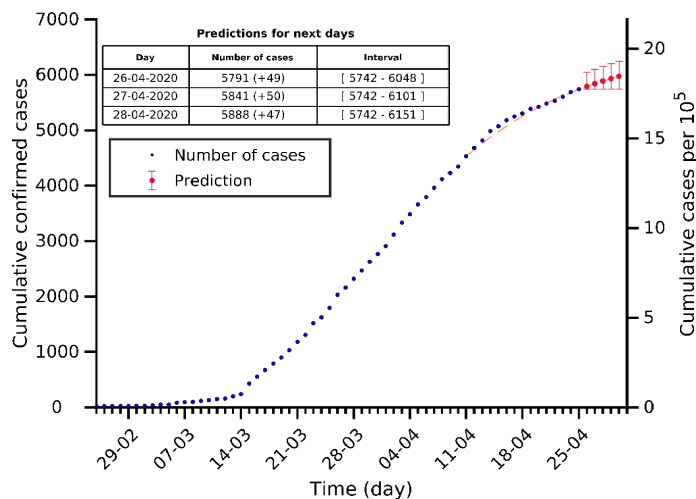
# Philippines 25-04-2020. Population: 109.6M. Current cumulated incidence: 7/10<sup>5</sup>



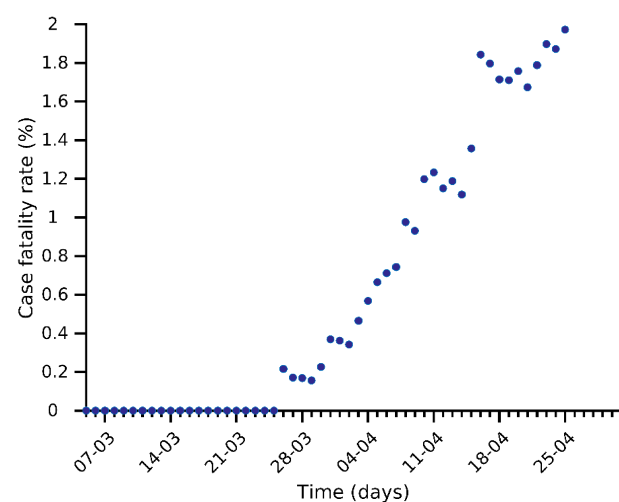
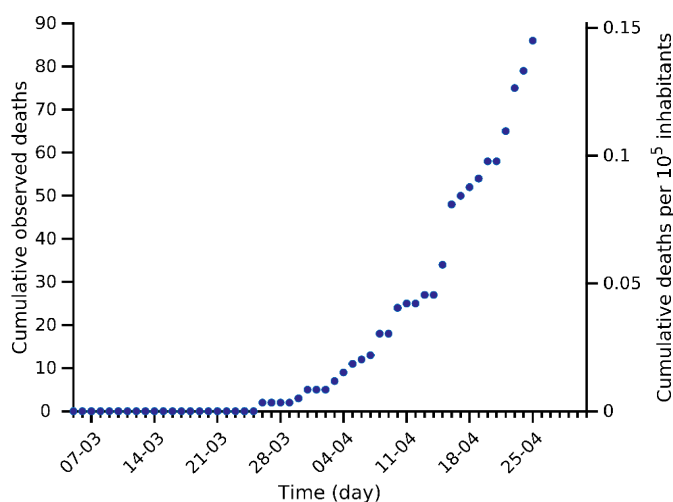
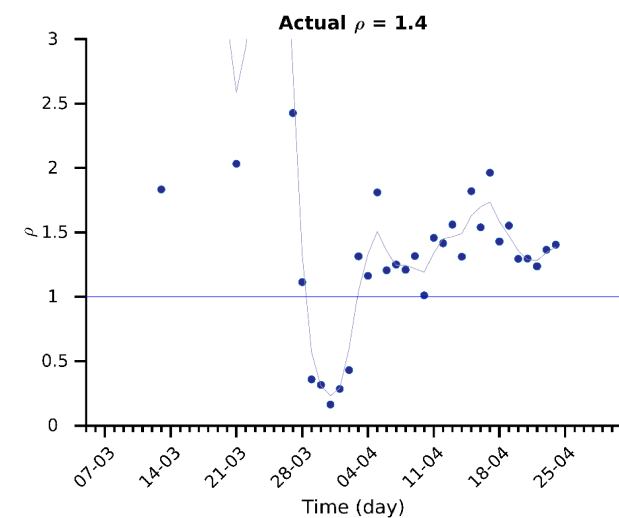
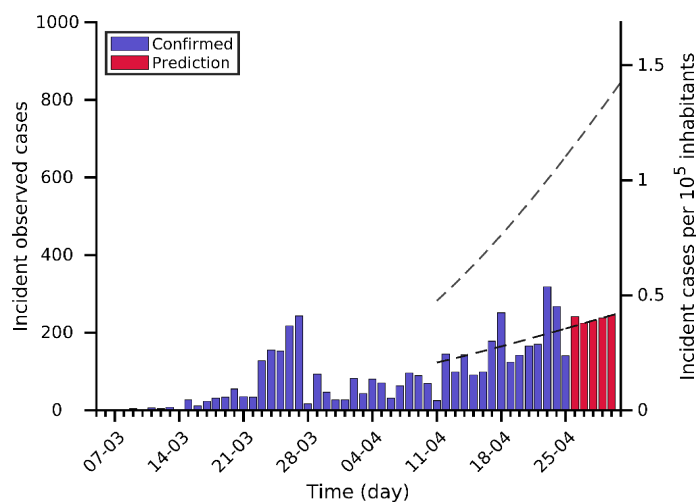
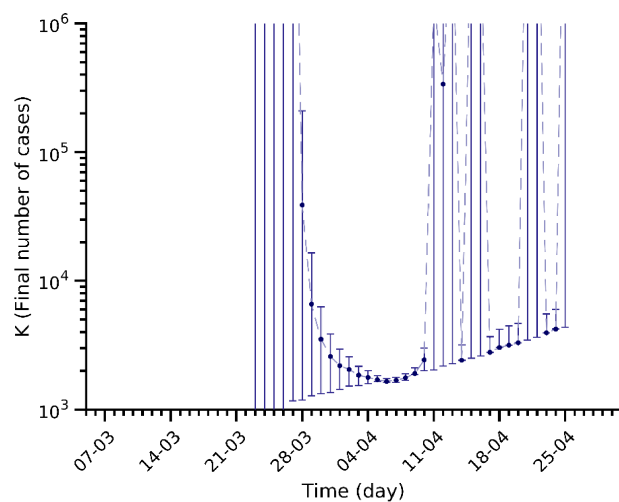
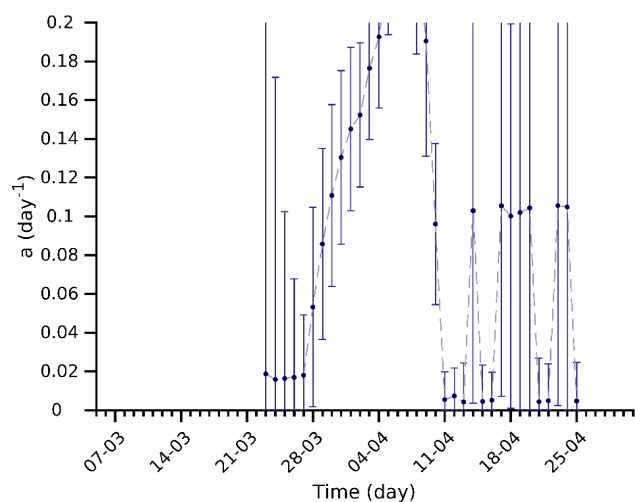
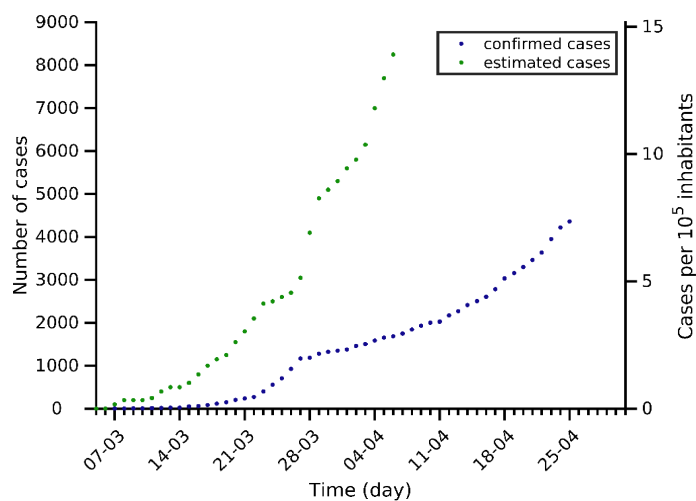
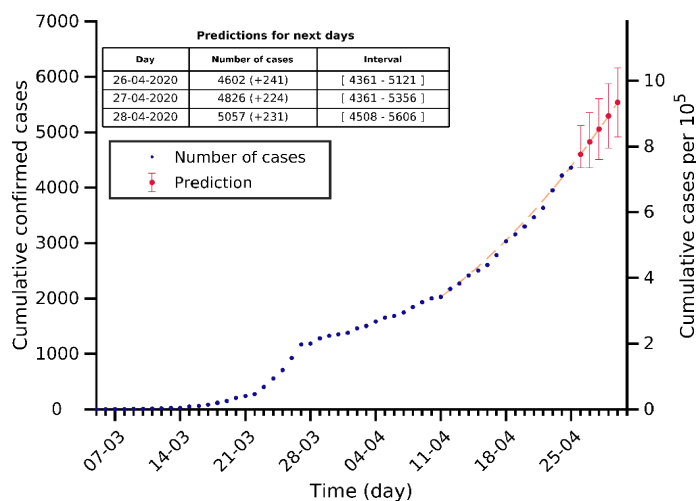
# Australia 25-04-2020. Population: 25.5M. Current cumulated incidence: 26/10<sup>5</sup>



# Malaysia 25-04-2020. Population: 32.4M. Current cumulated incidence: 18/10<sup>5</sup>



# South Africa 25-04-2020. Population: 59.3M. Current cumulated incidence: 7/10<sup>5</sup>

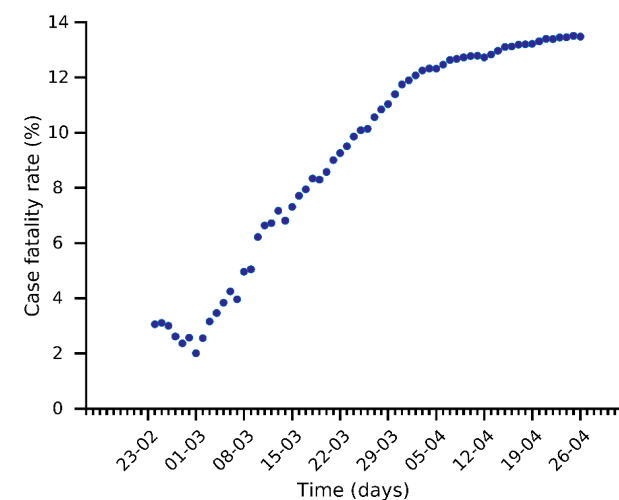
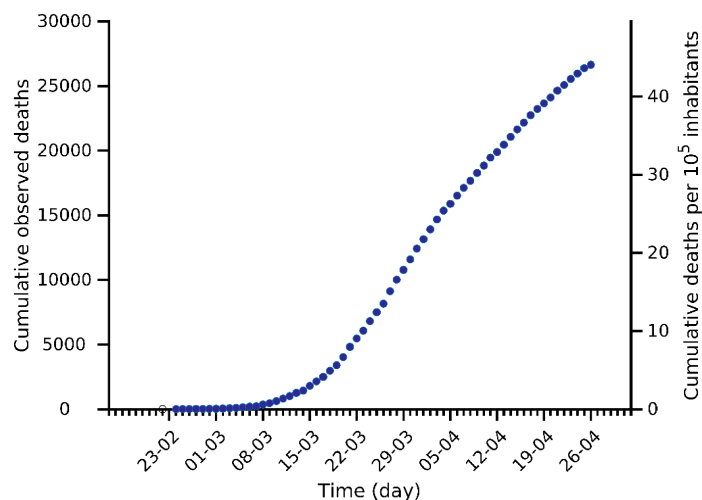
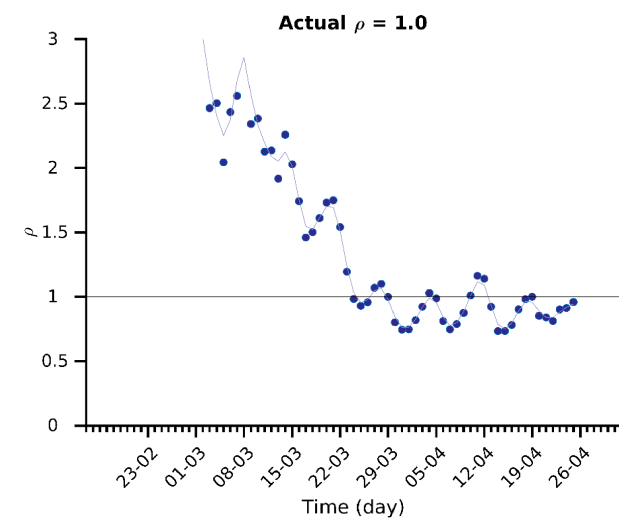
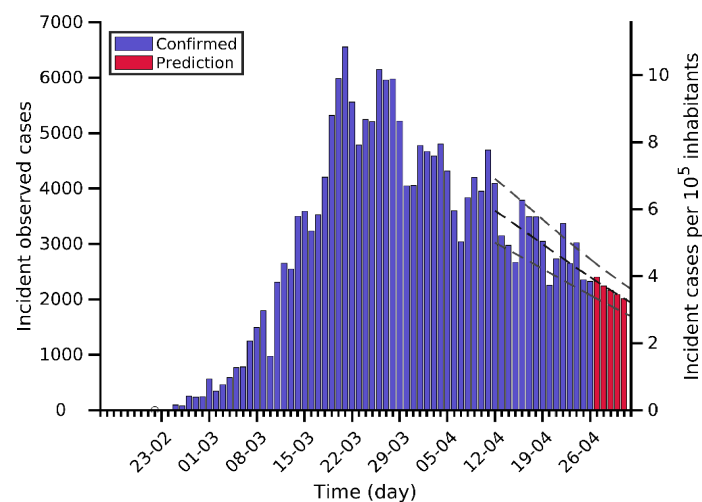
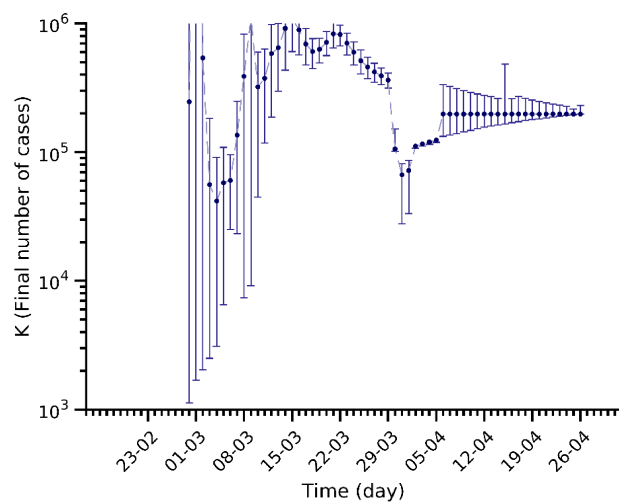
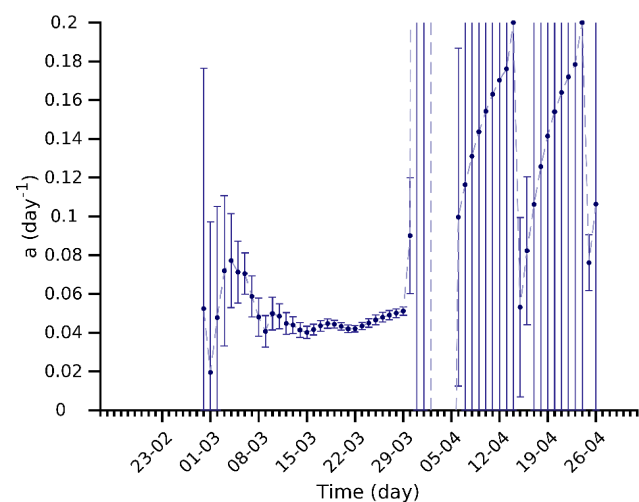
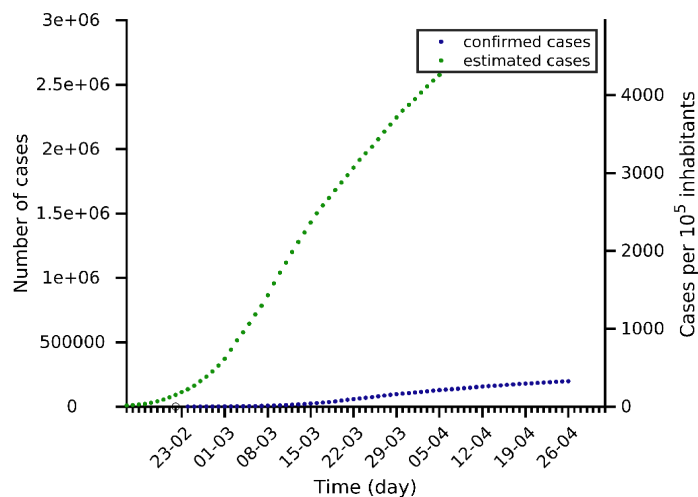
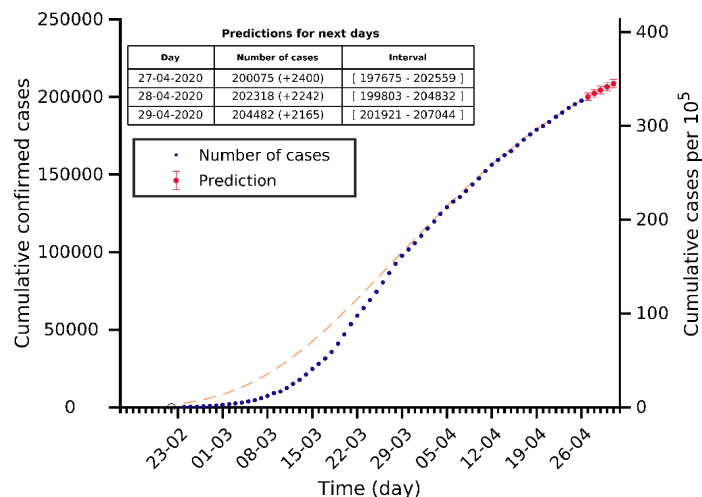


### **(3) Analysis and prediction of COVID-19 for Italy and its regions**

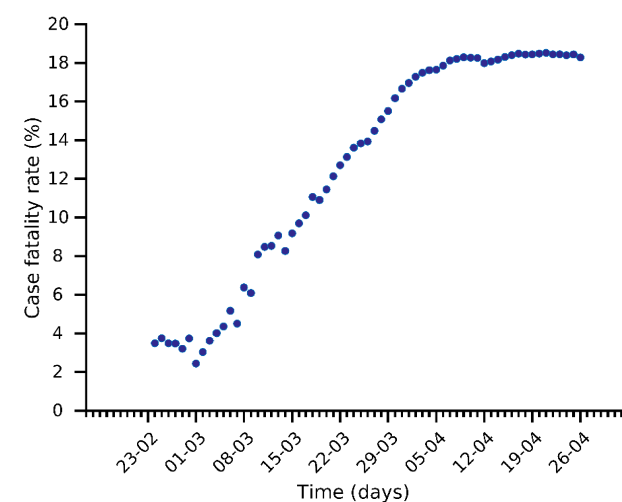
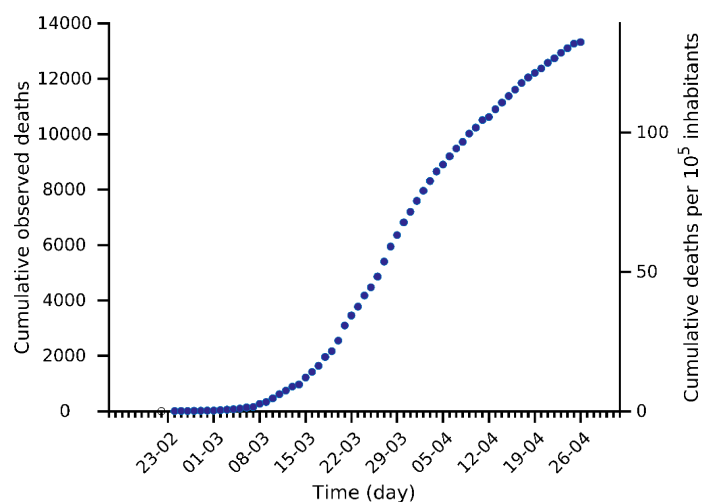
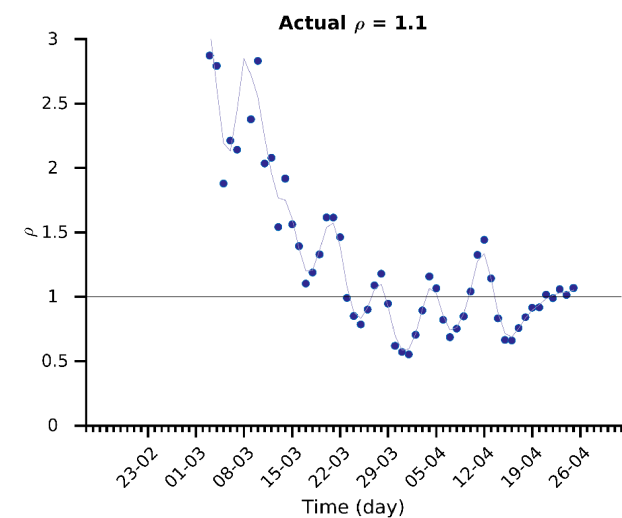
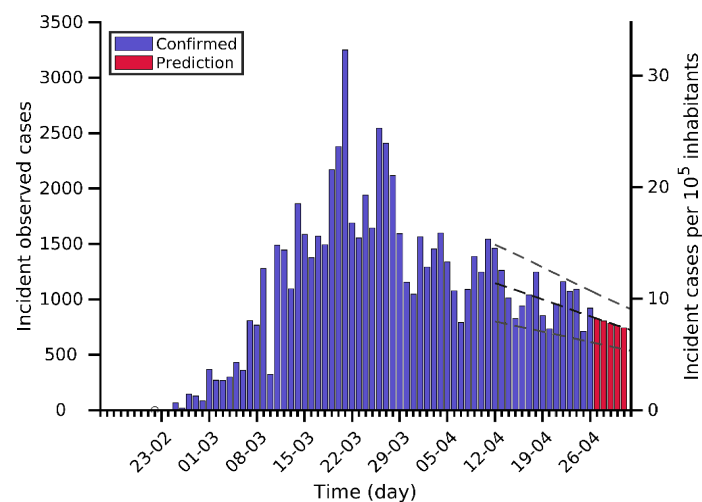
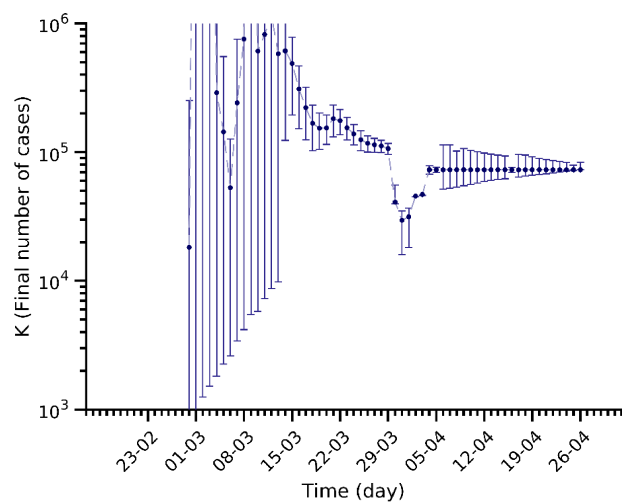
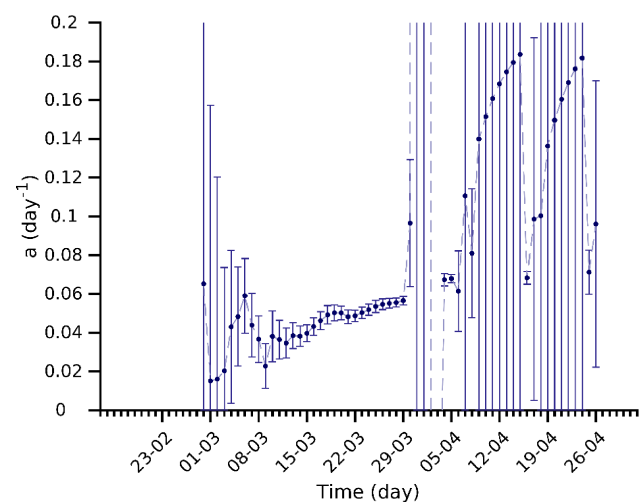
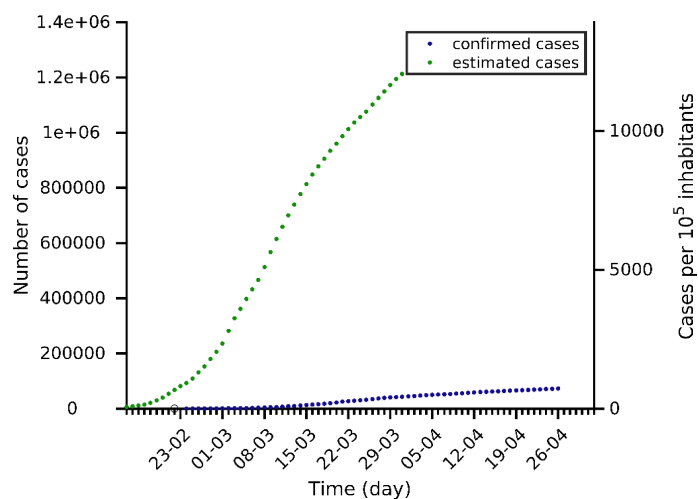
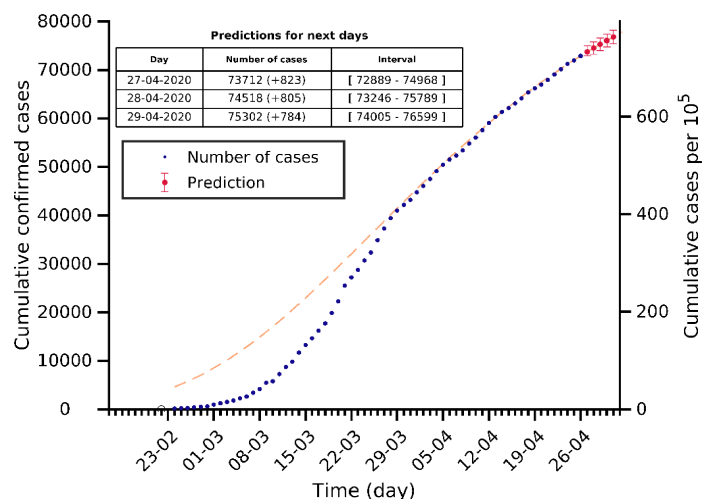
Data obtained from: <https://github.com/pcm-dpc/COVID-19/tree/master/dati-andamento-nazionale>



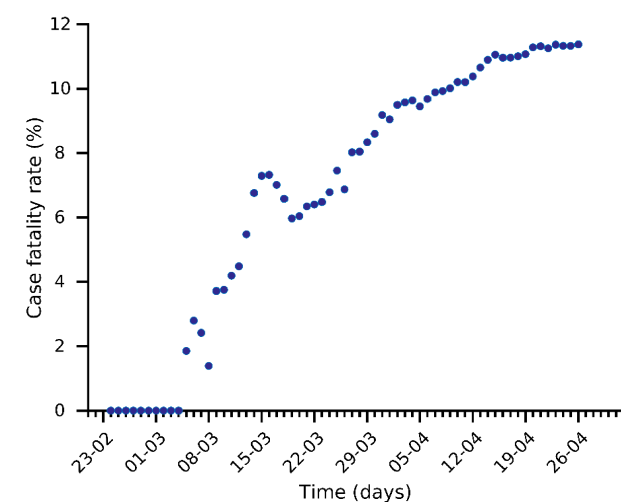
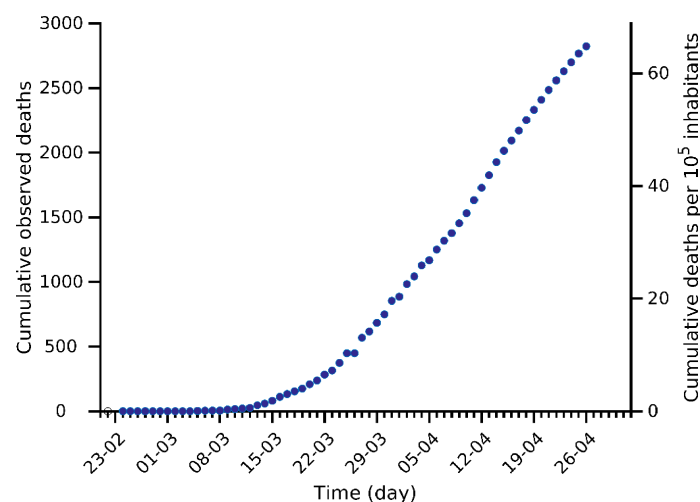
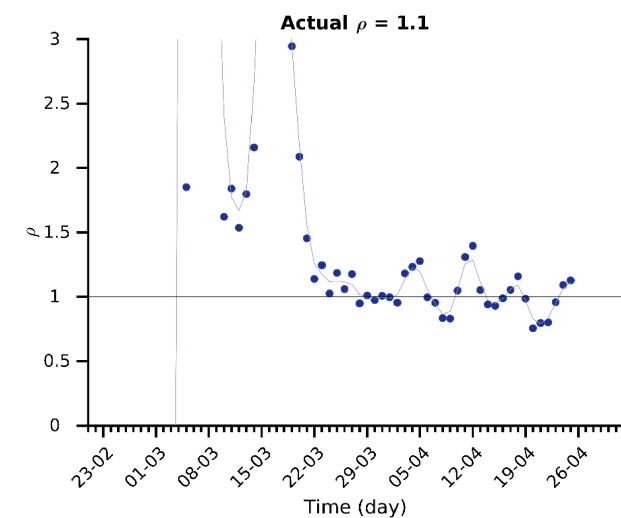
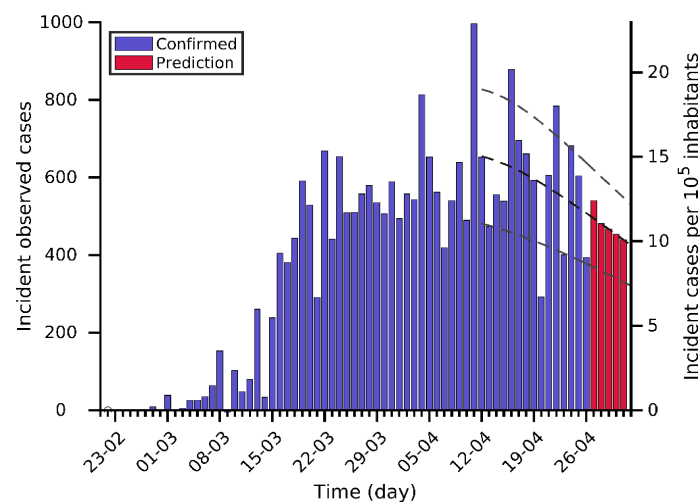
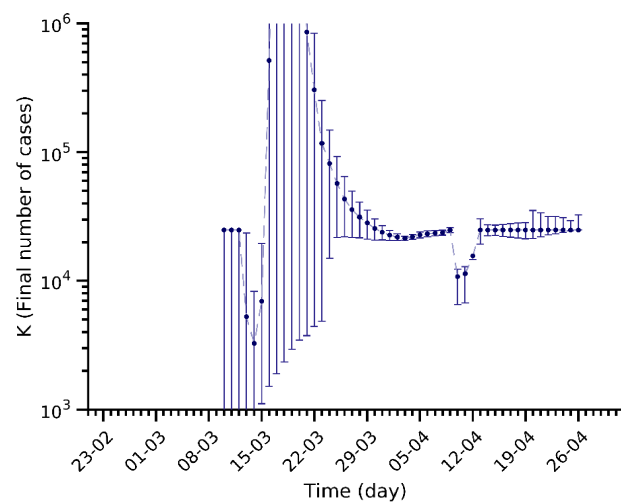
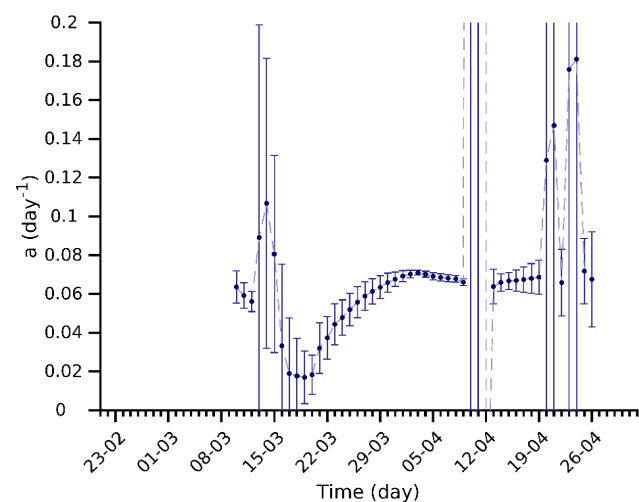
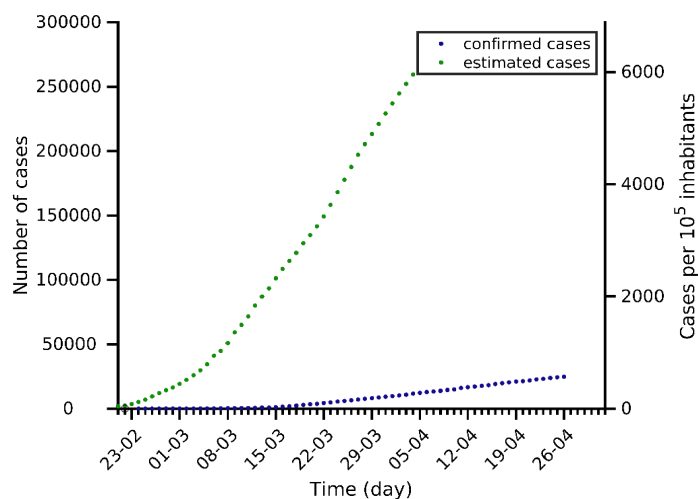
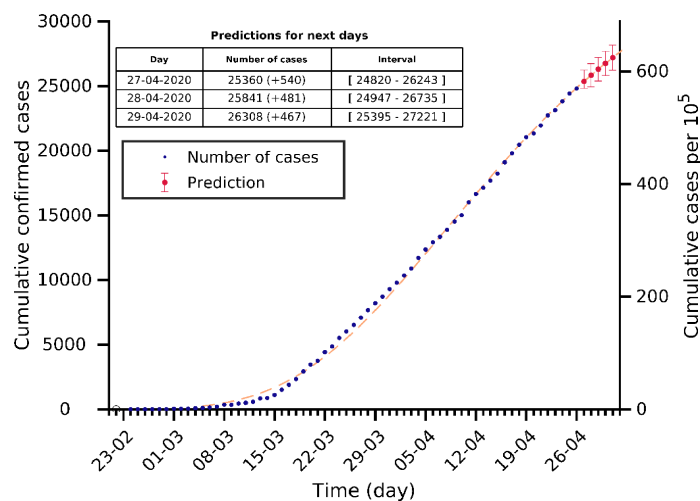
# Italy 26-04-2020. Population: 60.5M. Current cumulated incidence: 327/10<sup>5</sup>



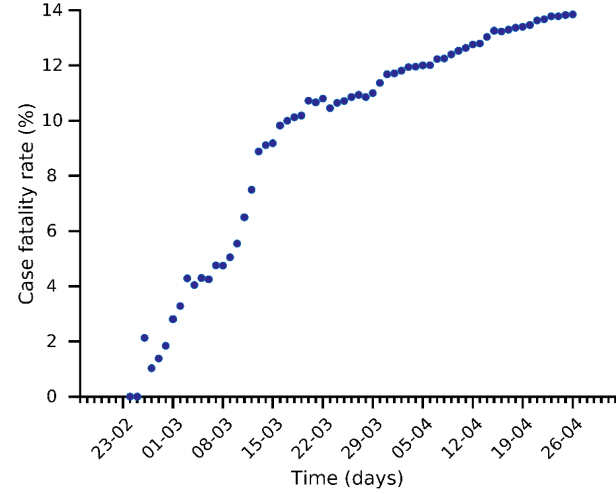
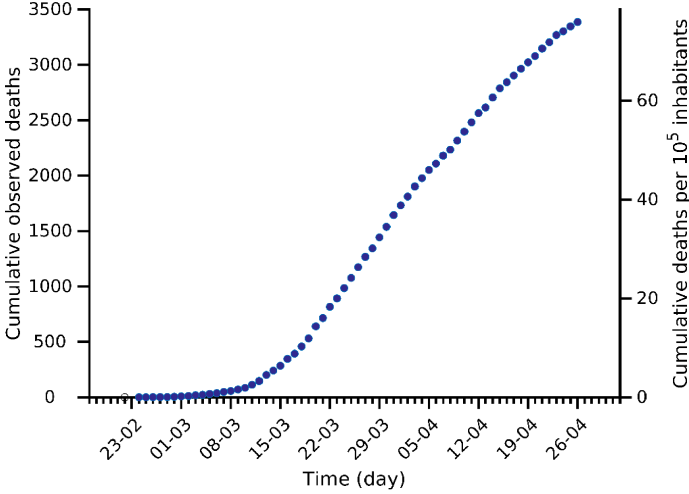
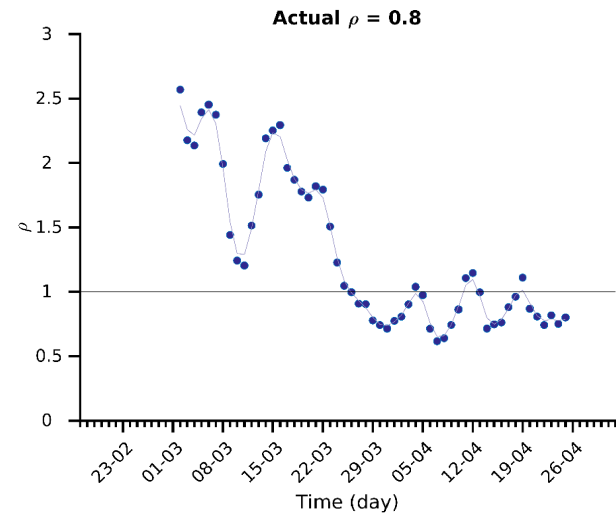
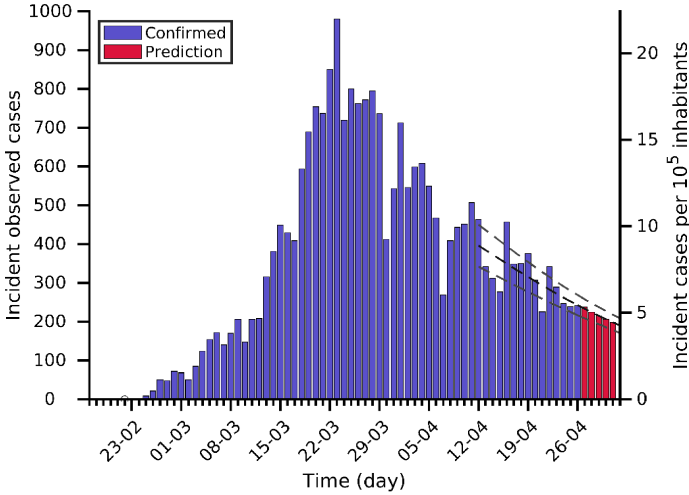
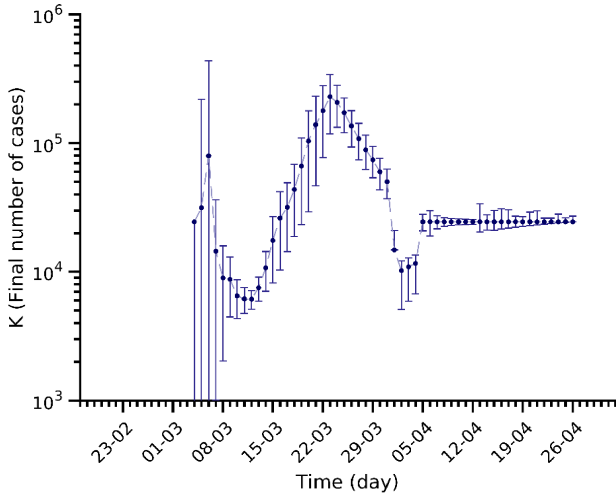
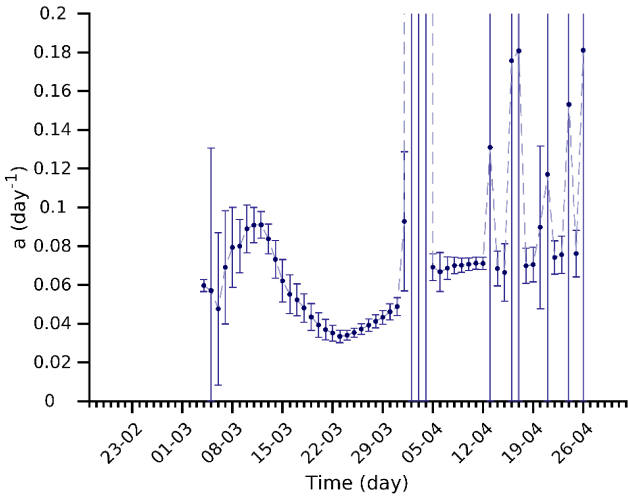
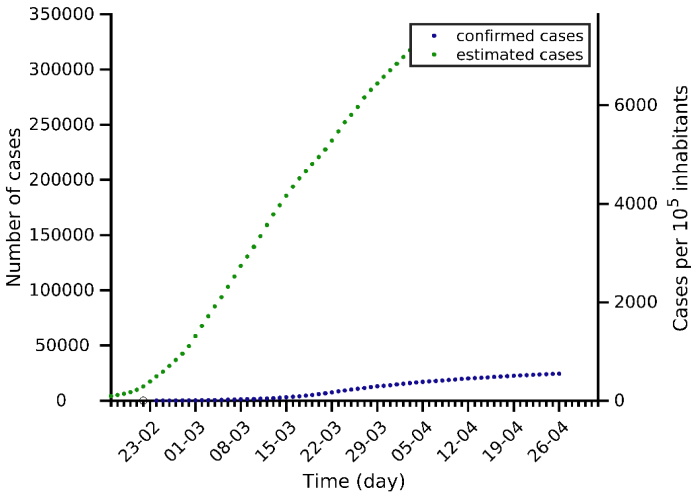
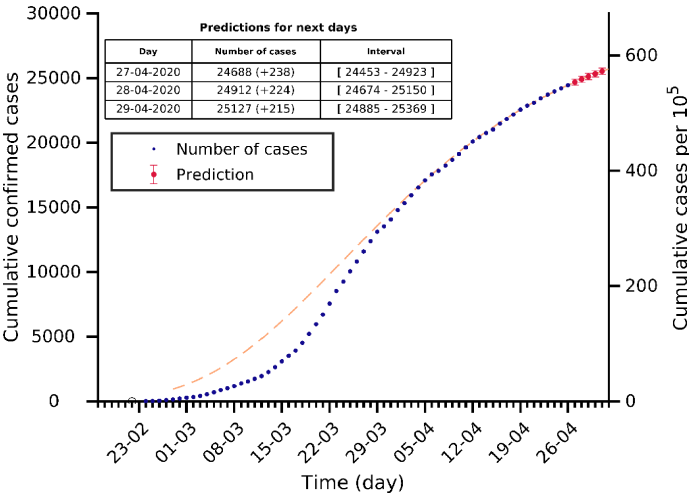
# Lombardia 26-04-2020. Population: 10.1M. Current cumulated incidence: 724/10<sup>5</sup>



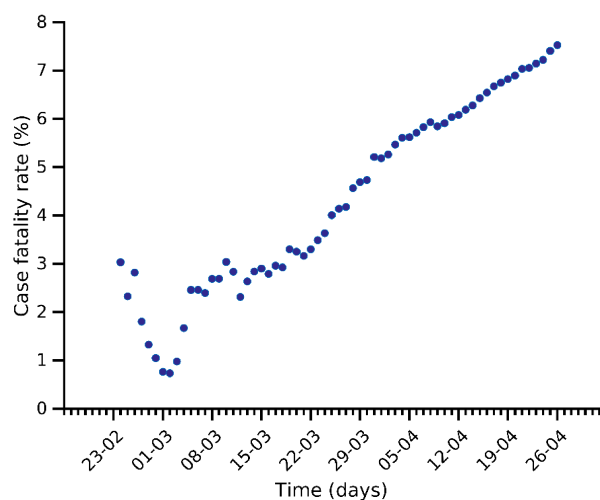
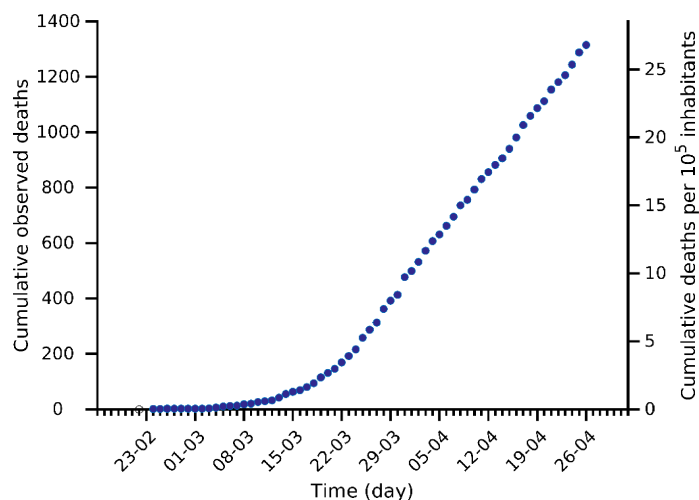
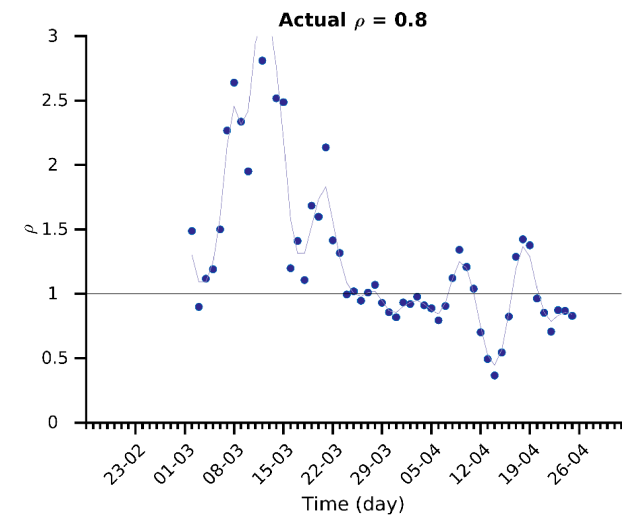
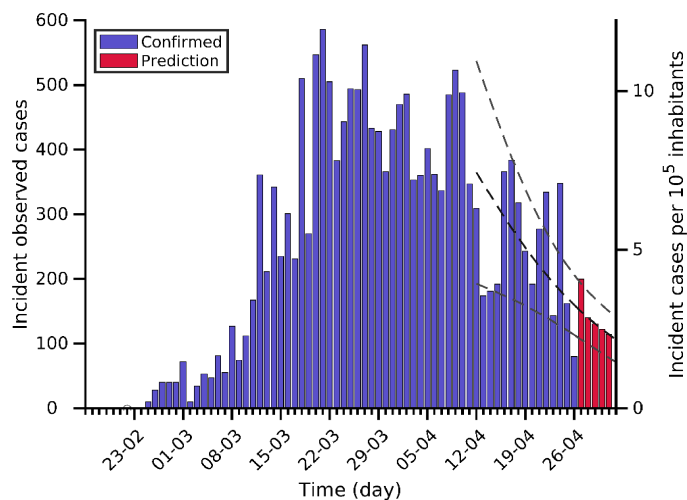
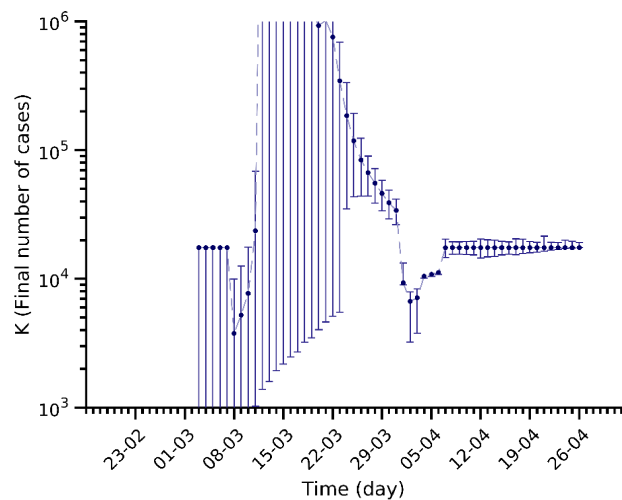
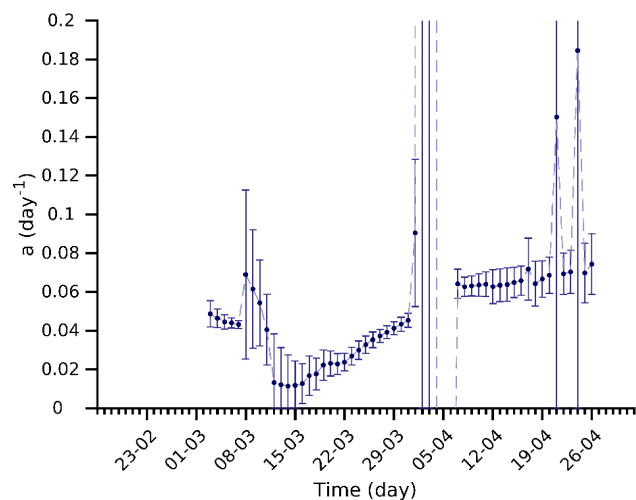
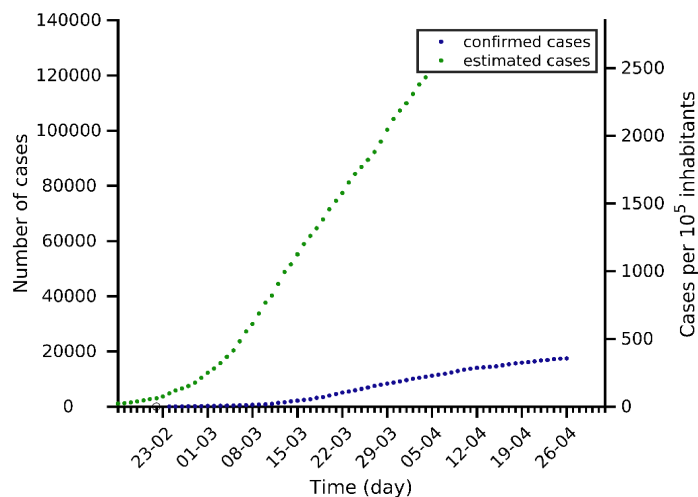
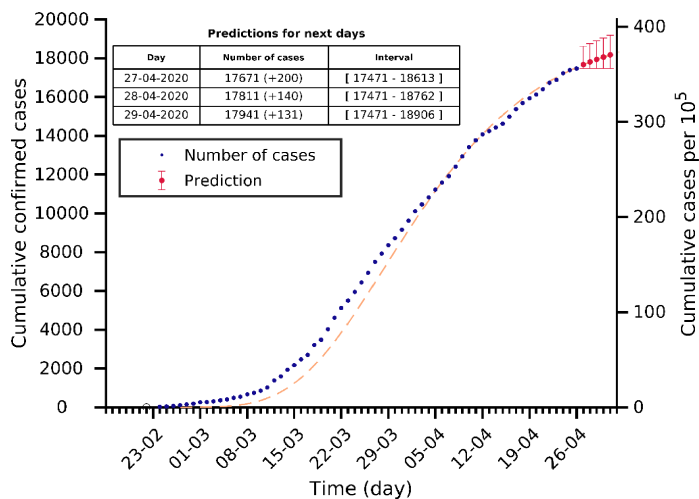
# Piemonte 26-04-2020. Population: 4.4M. Current cumulated incidence: 570/10<sup>5</sup>



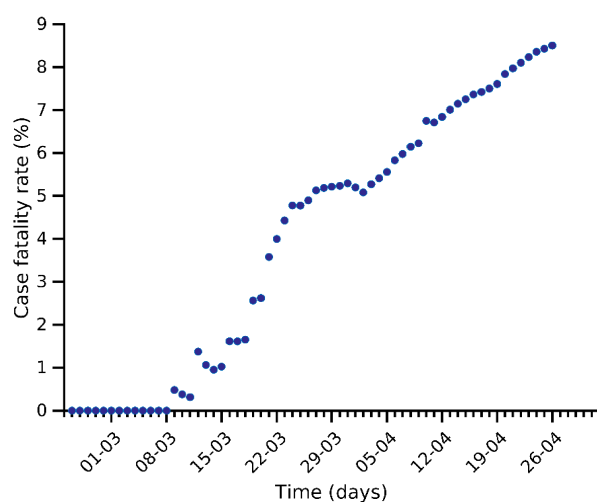
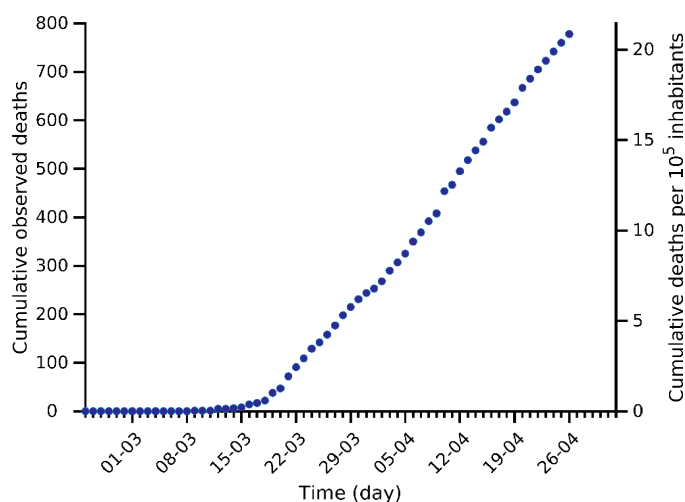
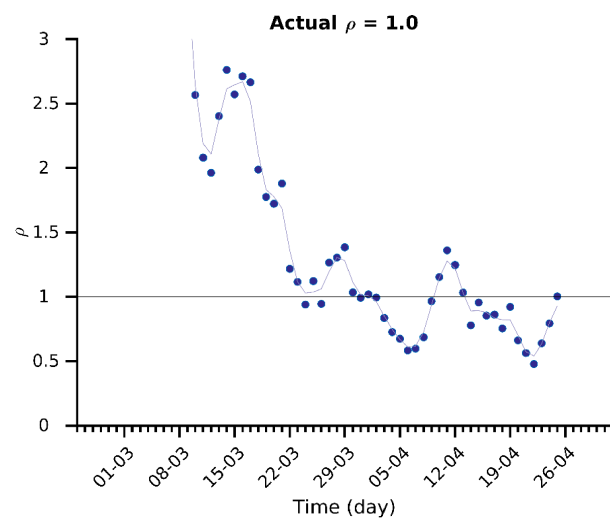
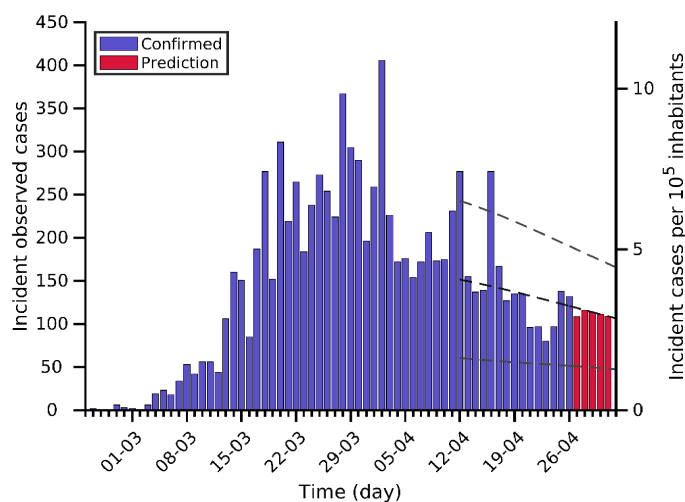
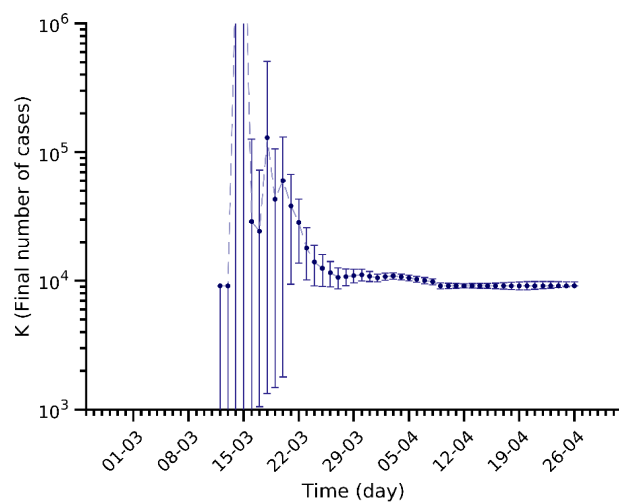
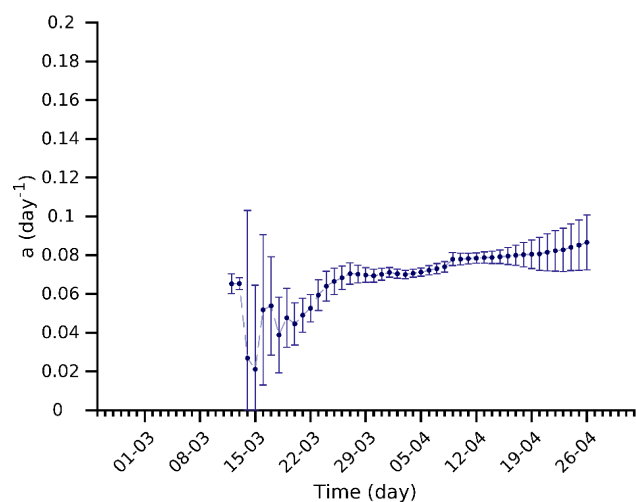
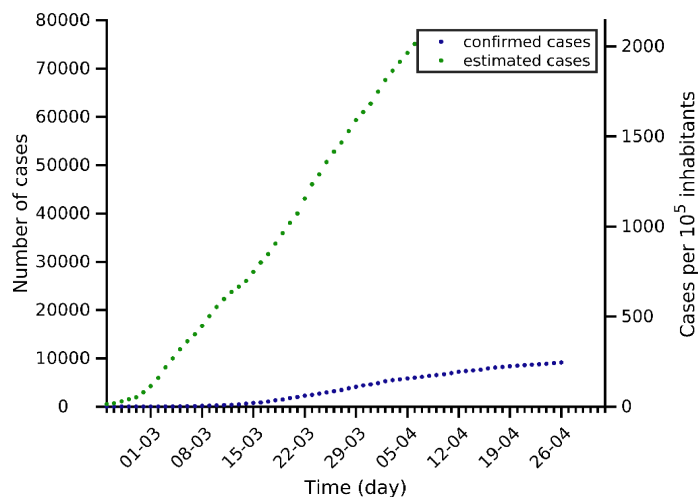
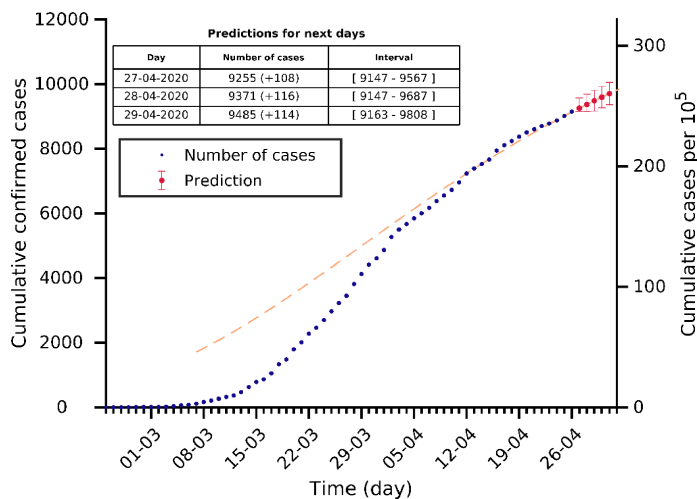
Emilia Romagna 26-04-2020. Population: 4.5M. Current cumulated incidence: 548/100,000



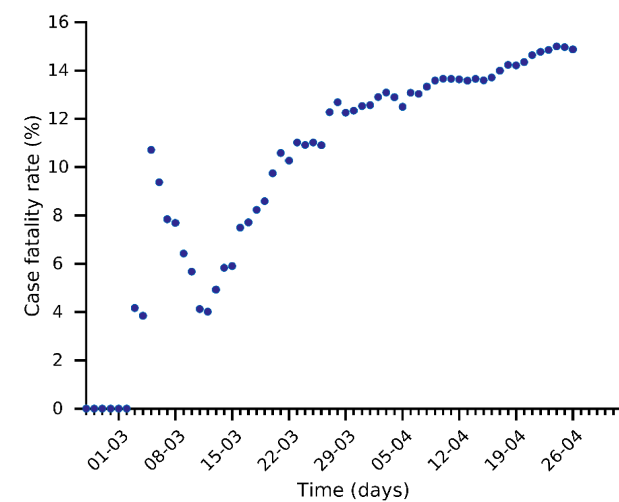
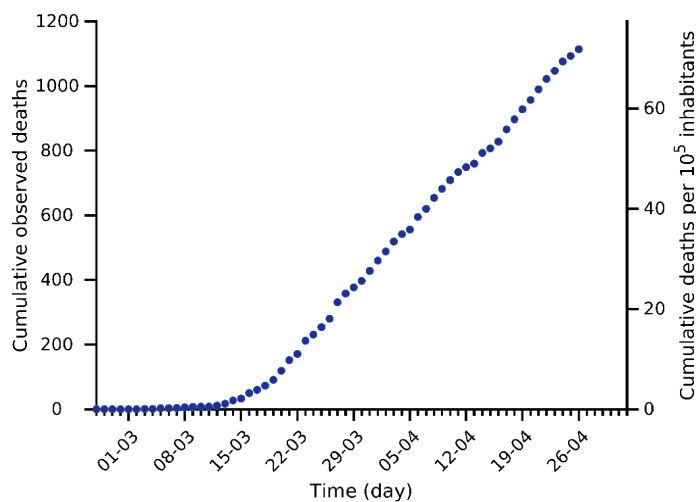
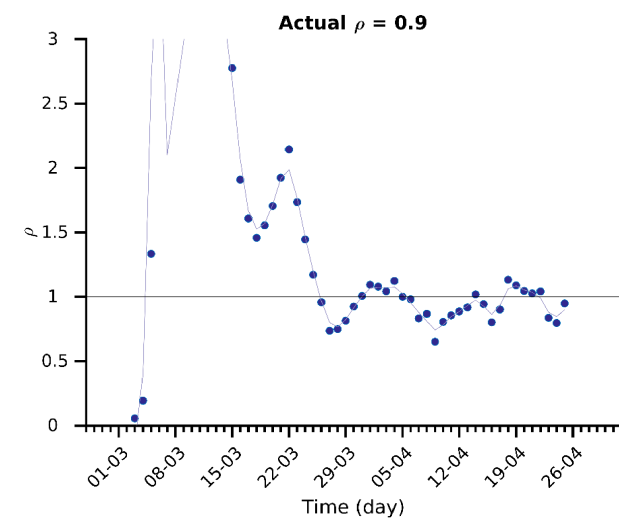
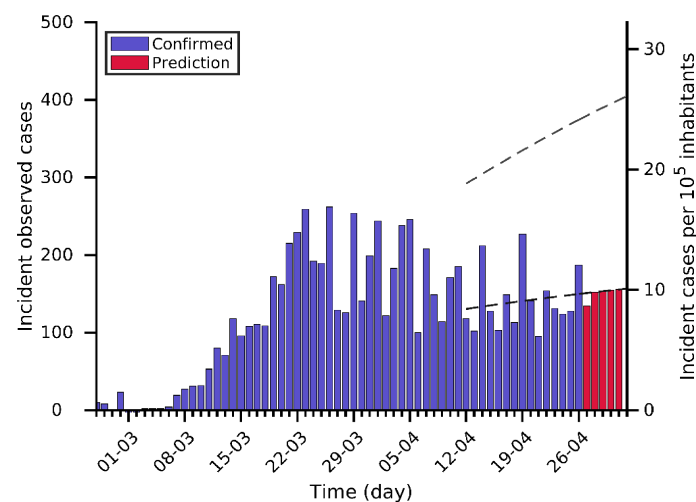
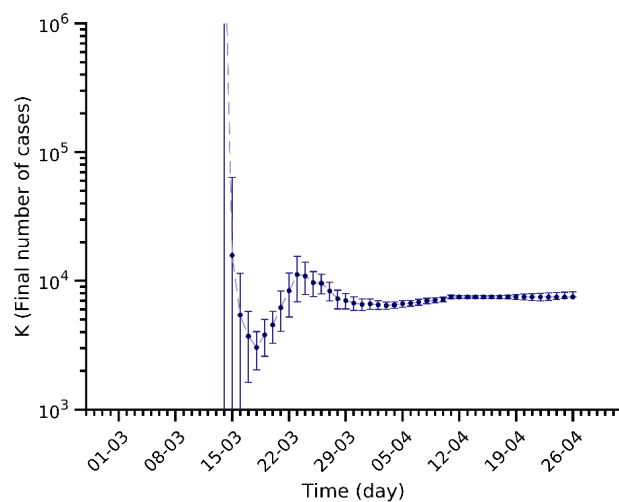
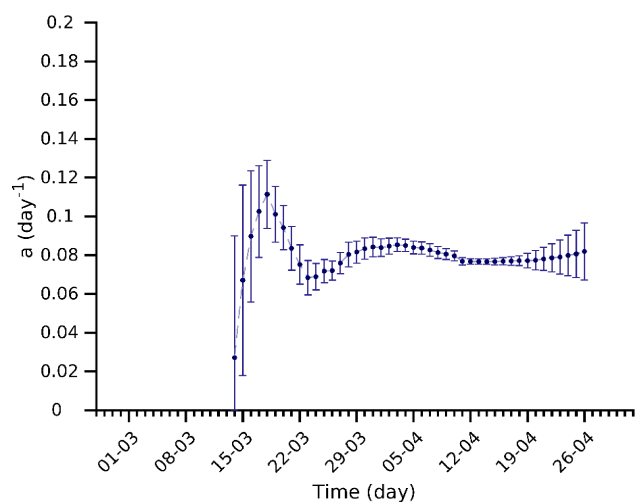
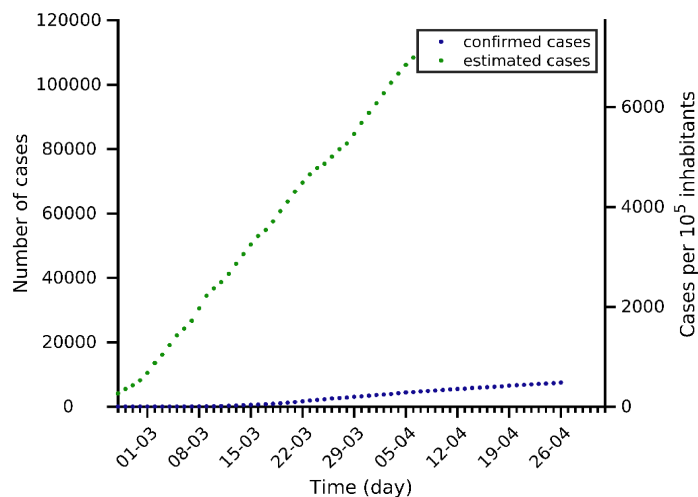
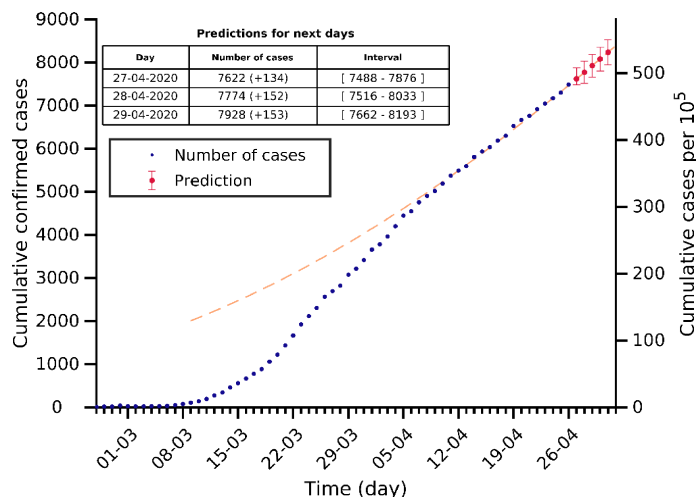
# Veneto 26-04-2020. Population: 4.9M. Current cumulated incidence: 356/10<sup>5</sup>



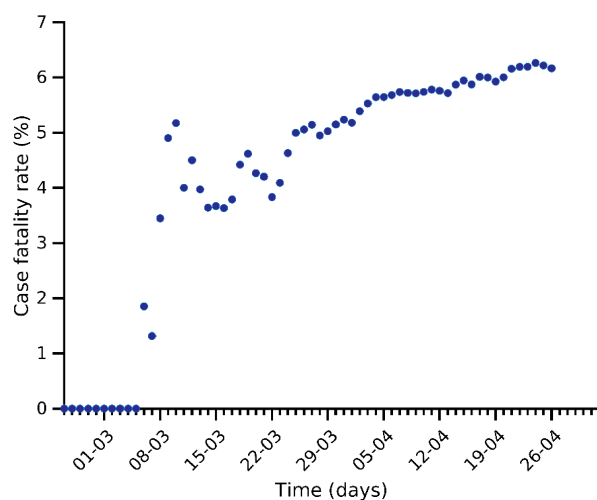
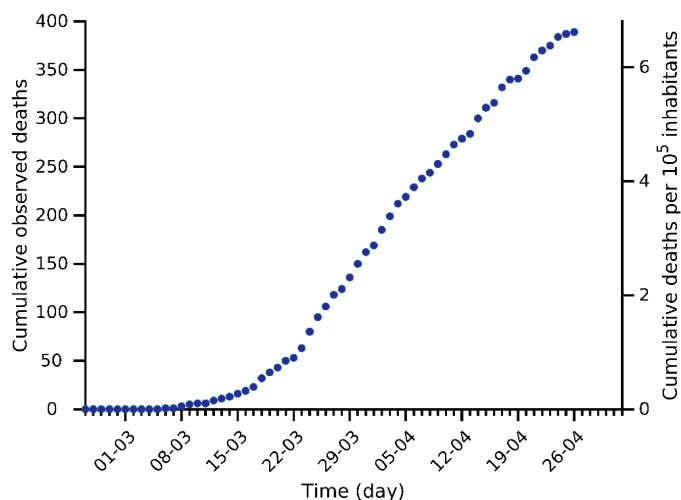
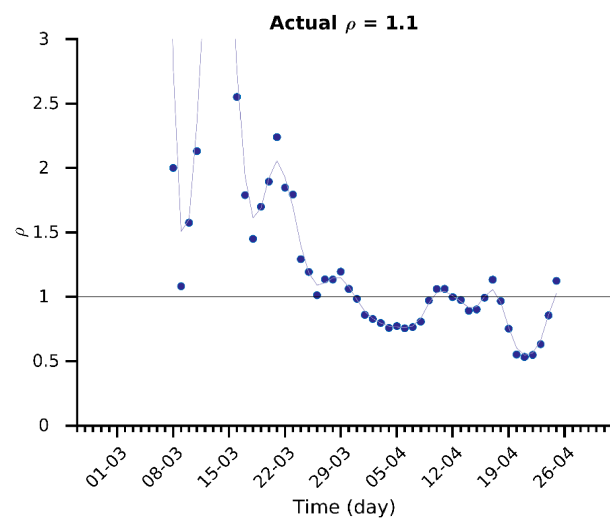
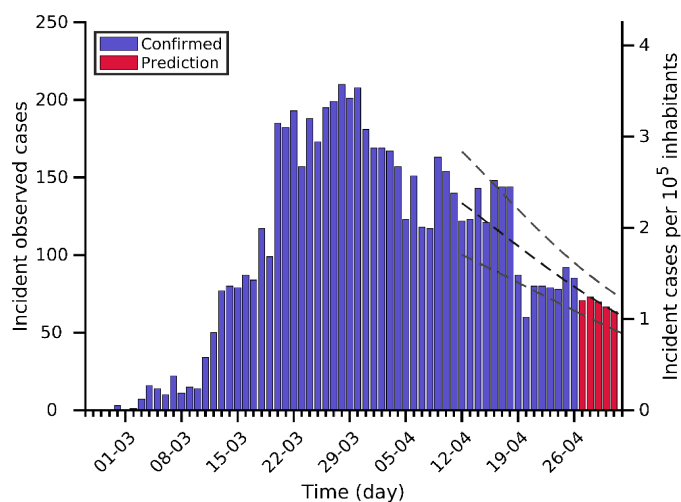
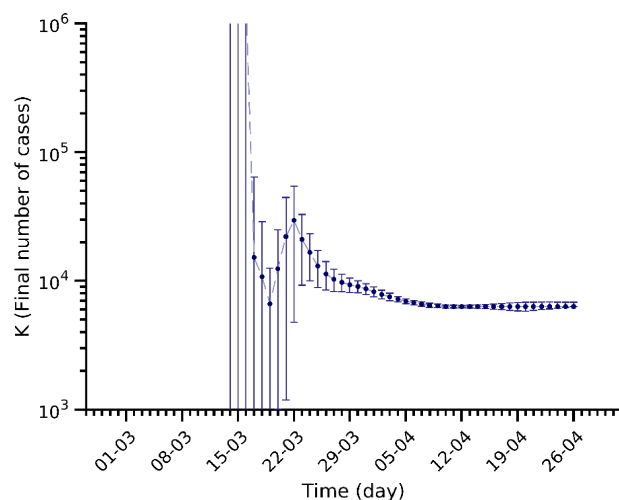
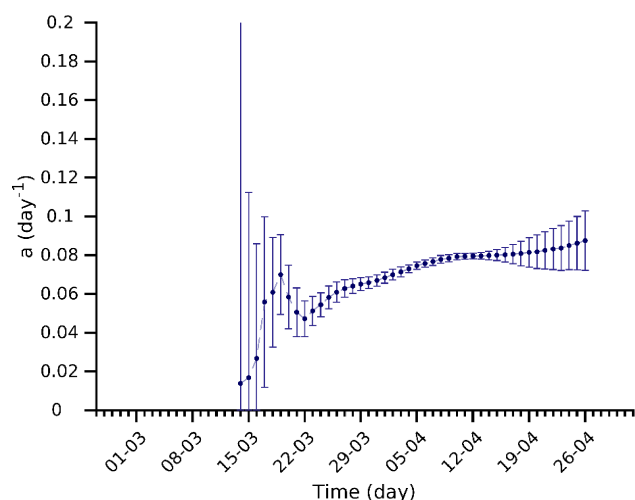
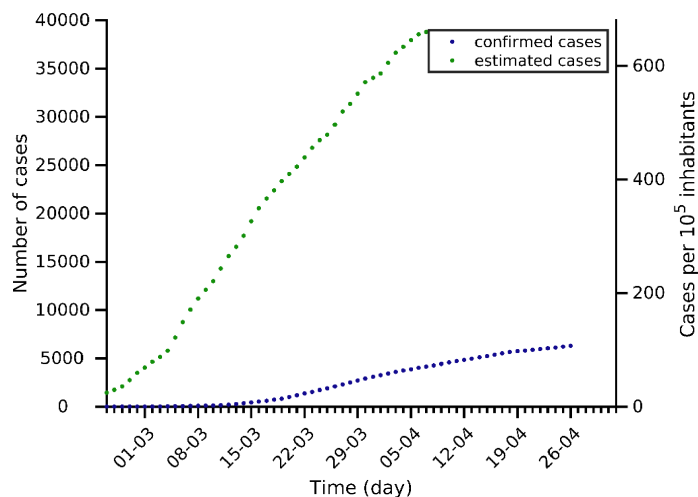
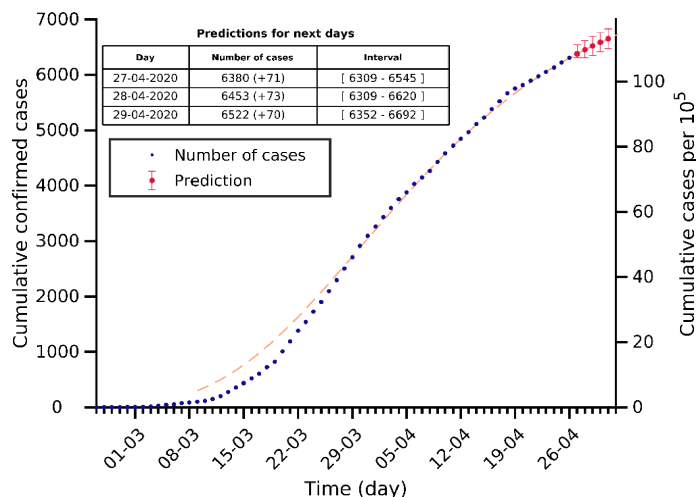
# Toscana 26-04-2020. Population: 3.7M. Current cumulated incidence: 245/10<sup>5</sup>



# Liguria 26-04-2020. Population: 1.6M. Current cumulated incidence: 483/10<sup>5</sup>

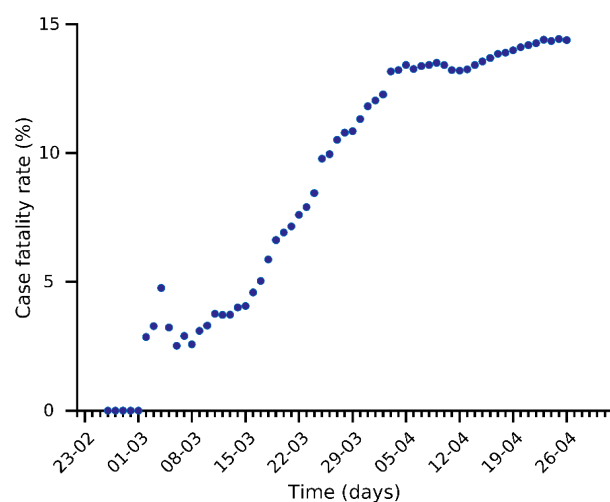
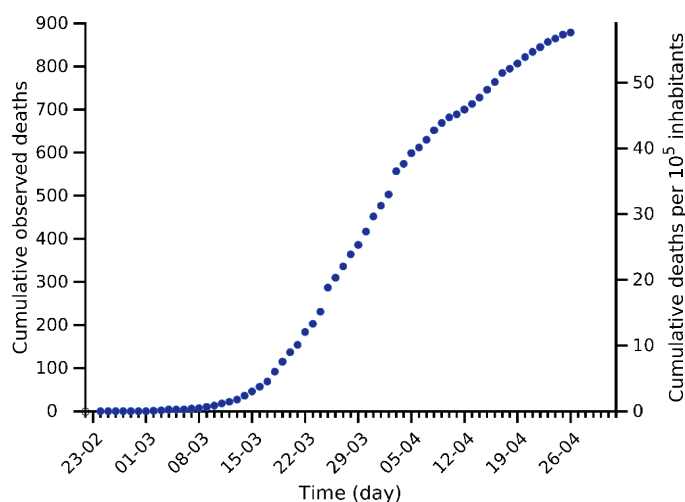
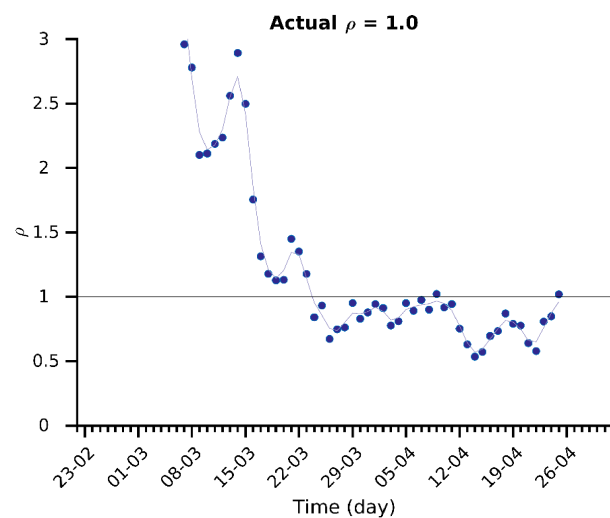
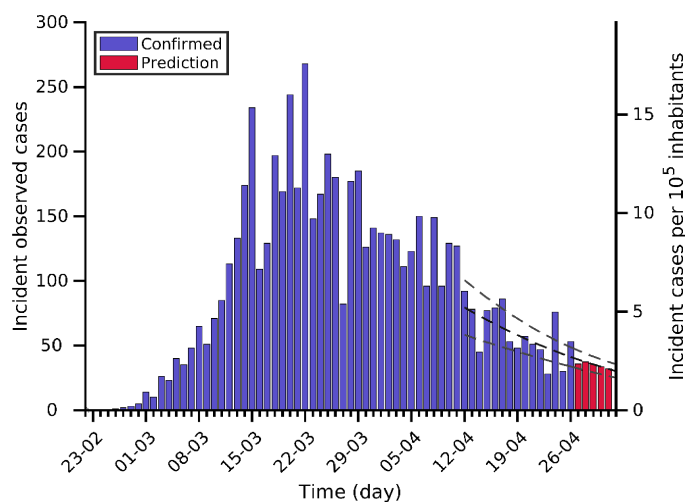
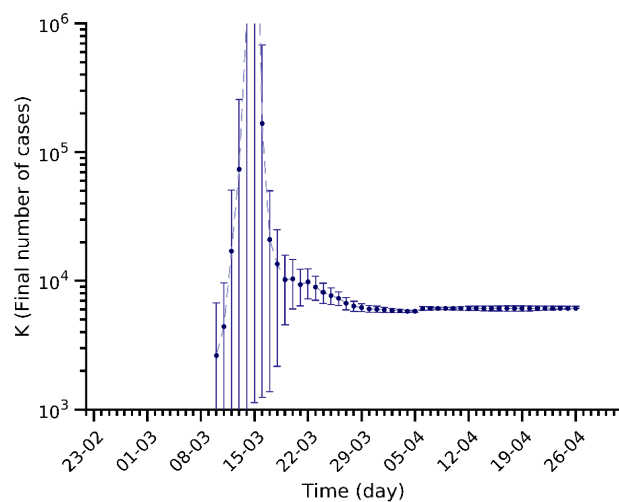
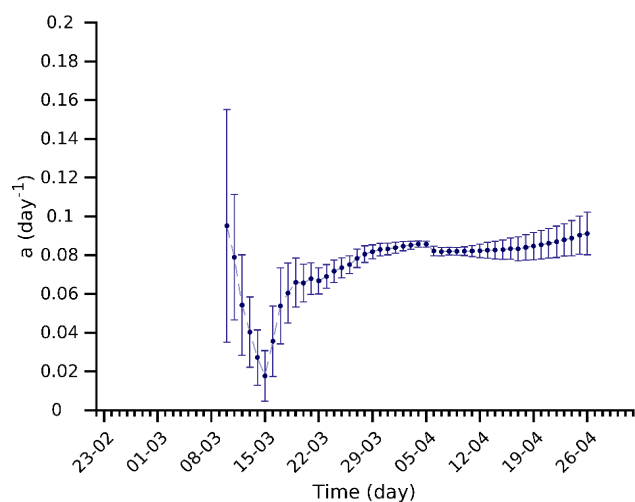
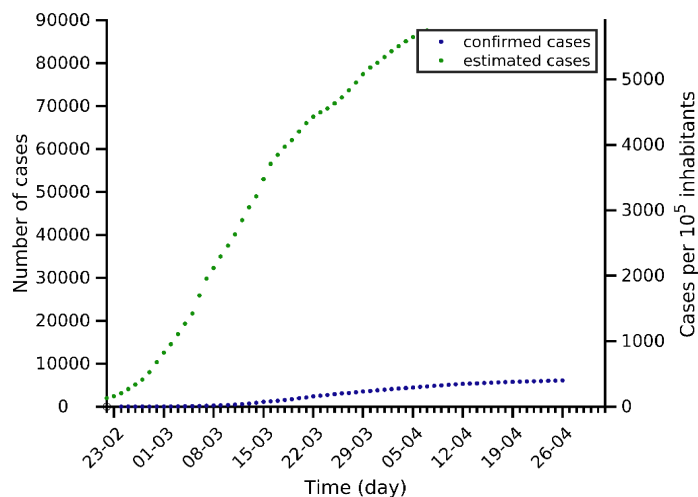
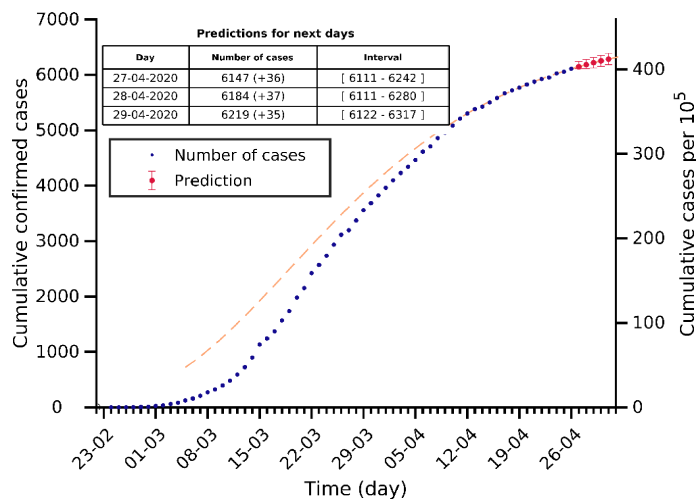


# Lazio 26-04-2020. Population: 5.9M. Current cumulated incidence: 107/10<sup>5</sup>

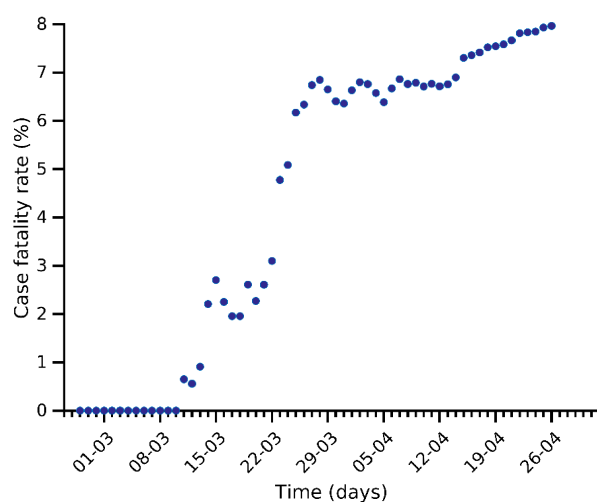
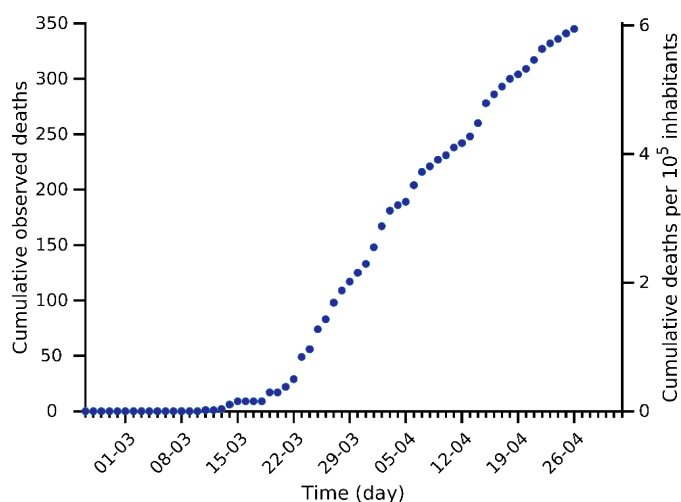
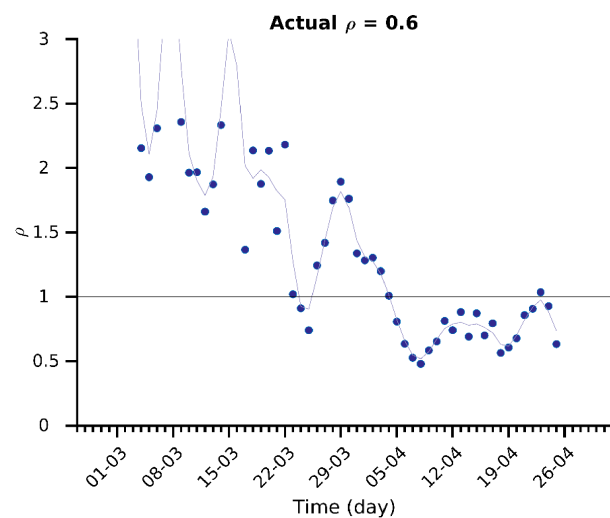
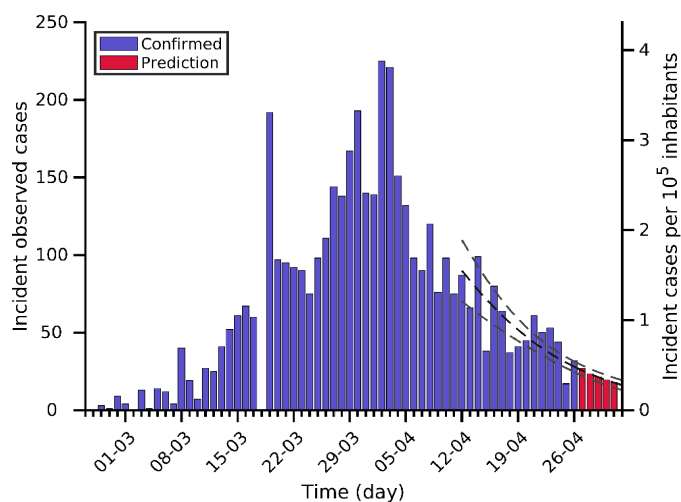
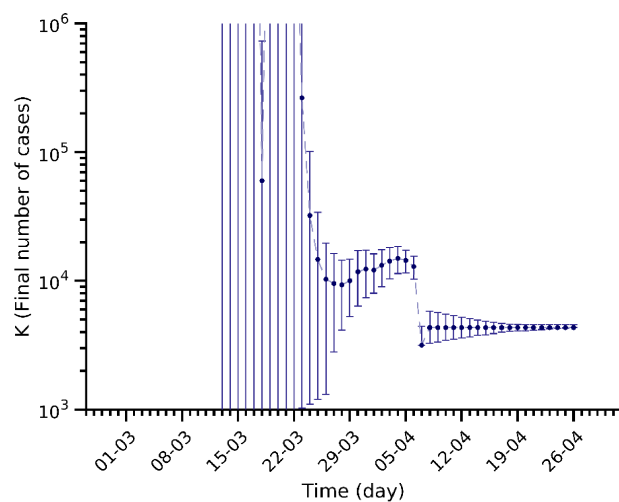
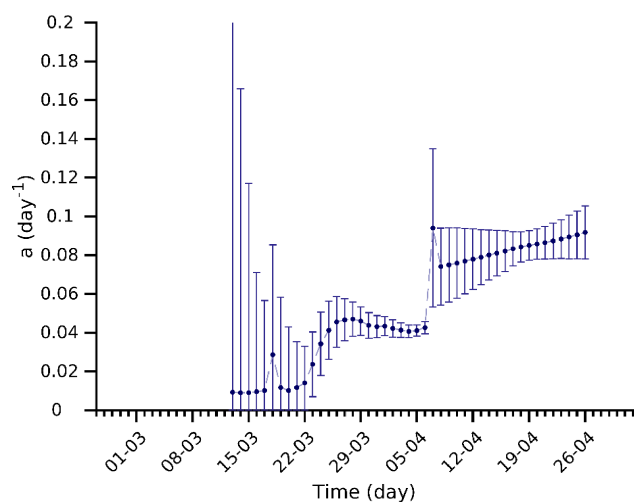
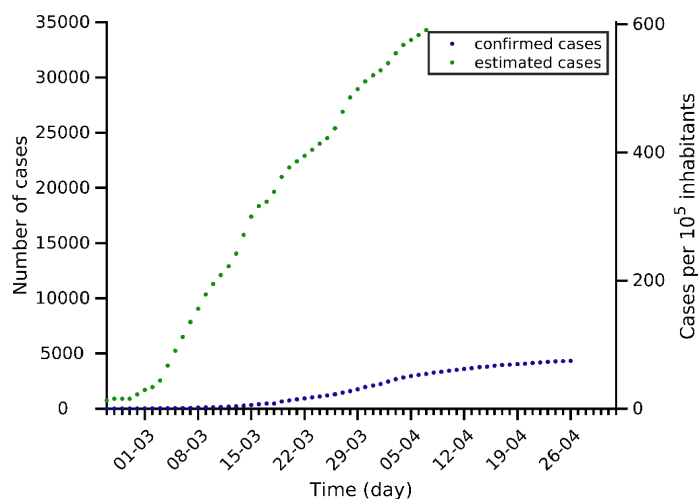
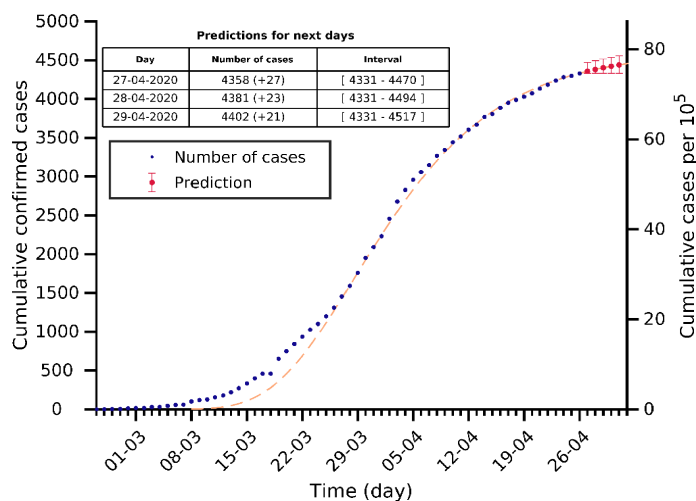




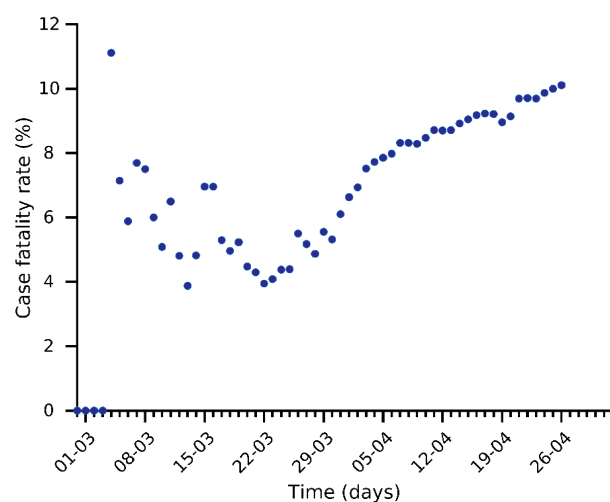
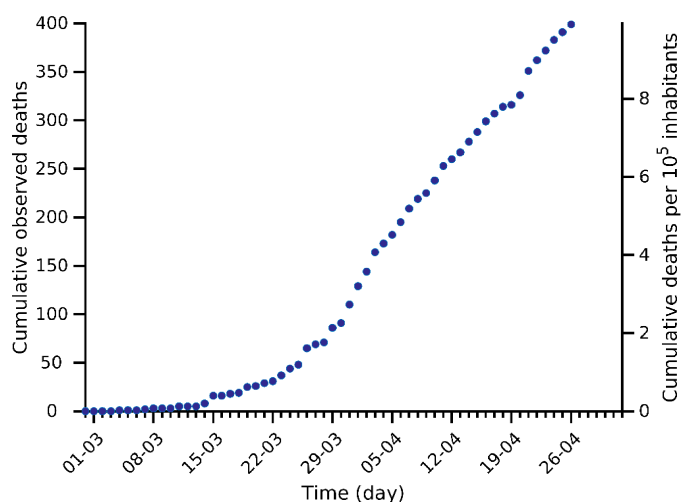
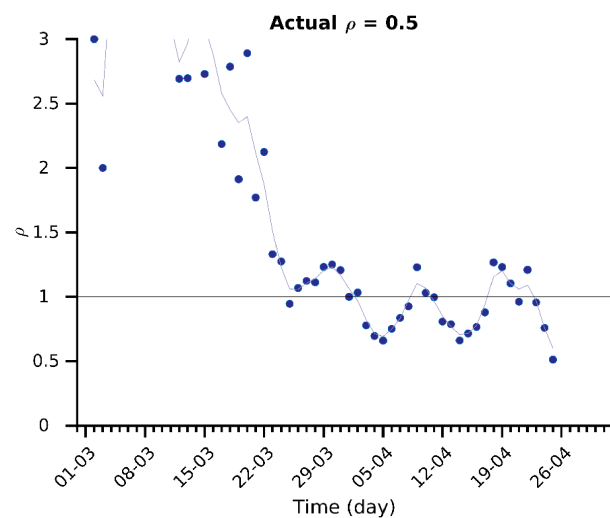
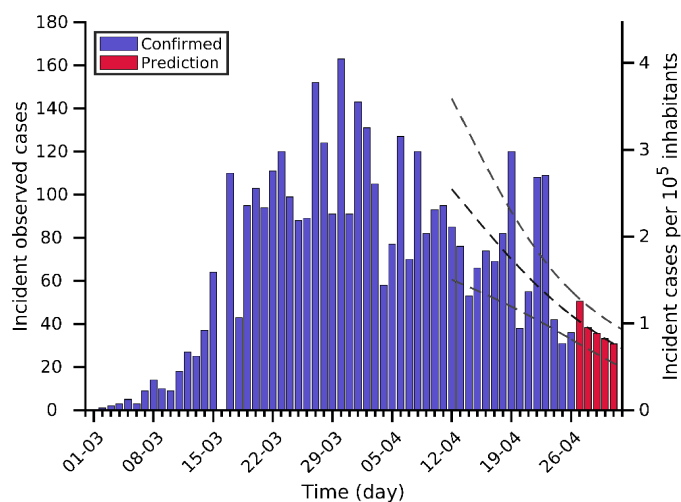
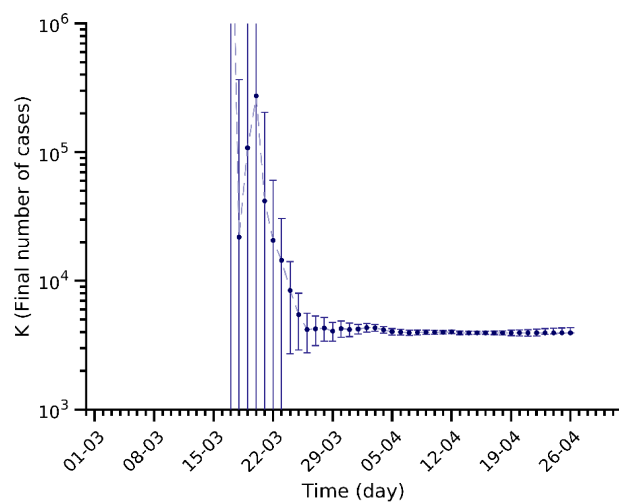
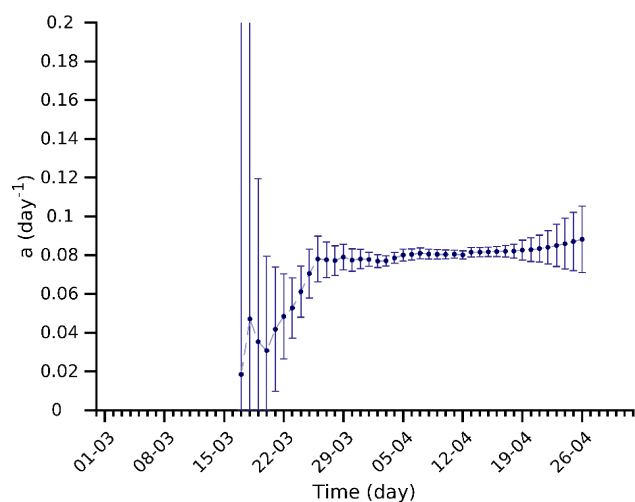
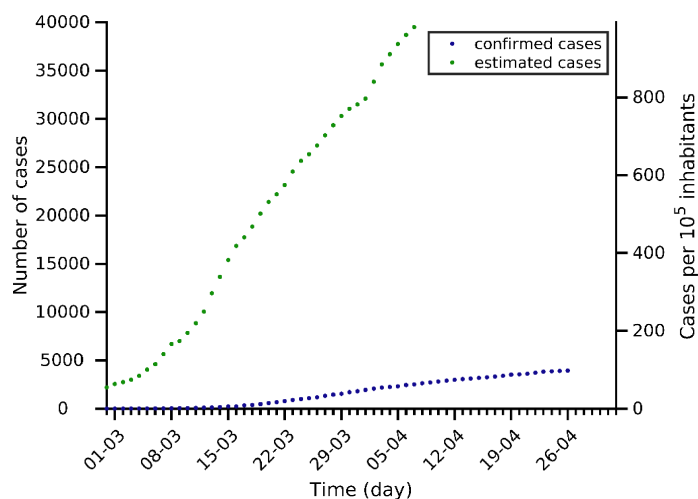
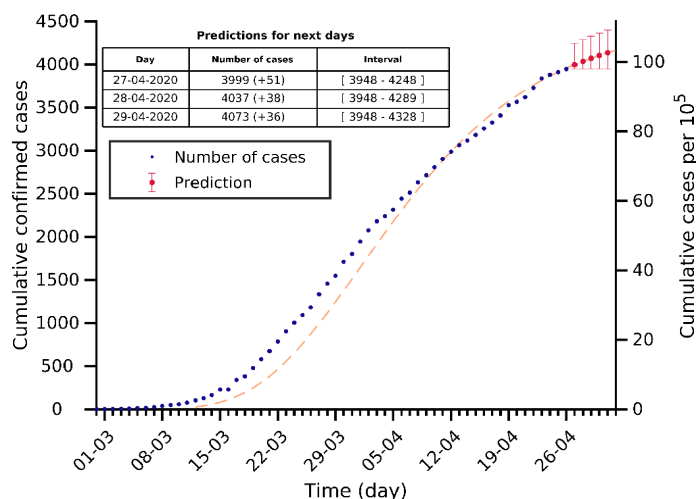
# **Marche 26-04-2020. Population: 1.5M. Current cumulated incidence: 401/10<sup>5</sup>**



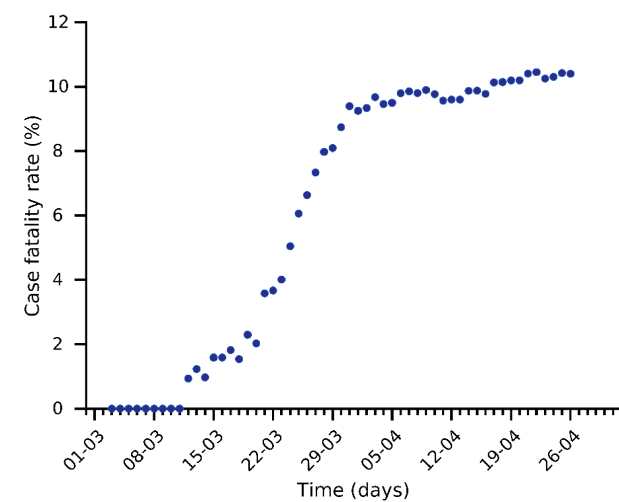
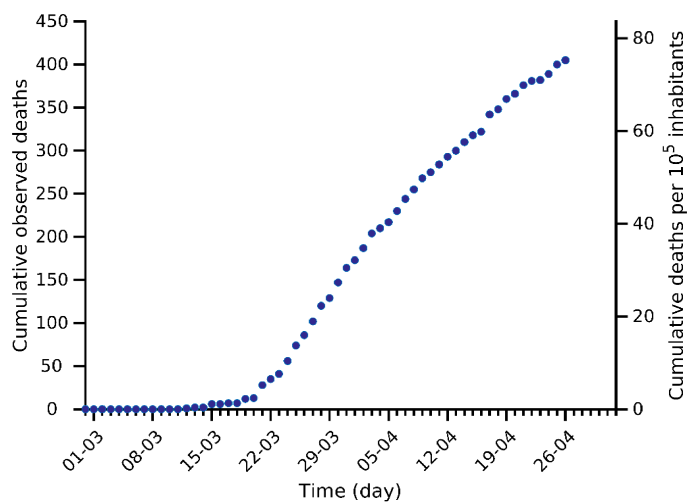
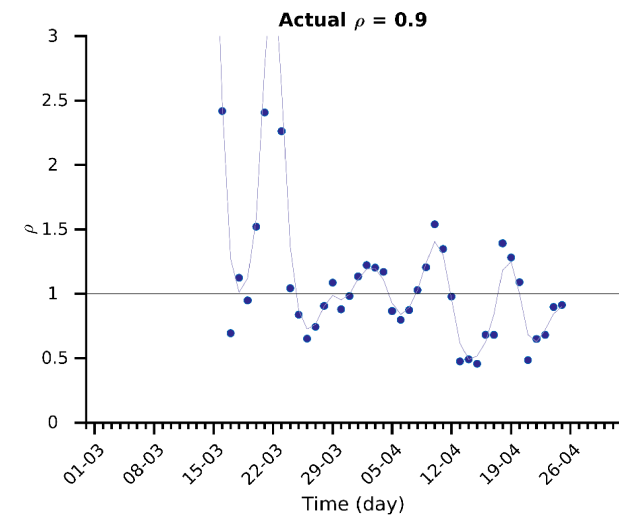
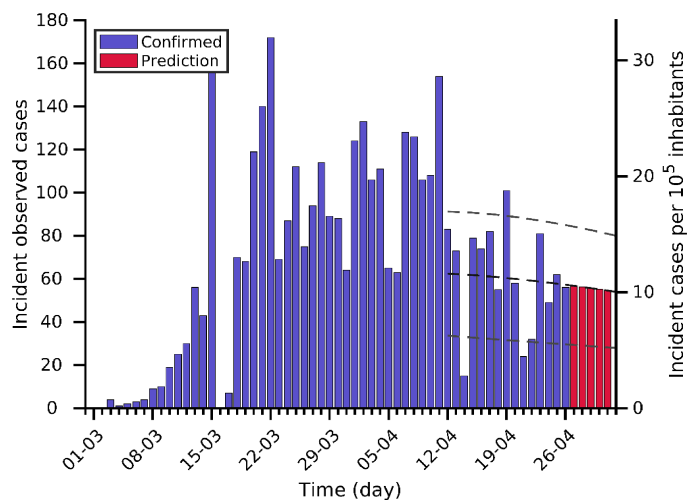
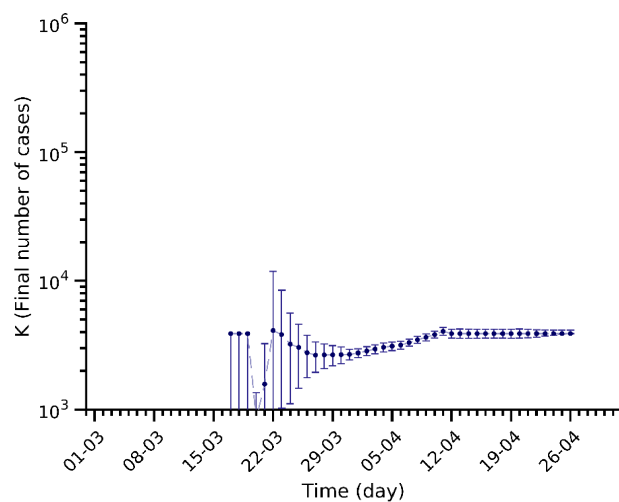
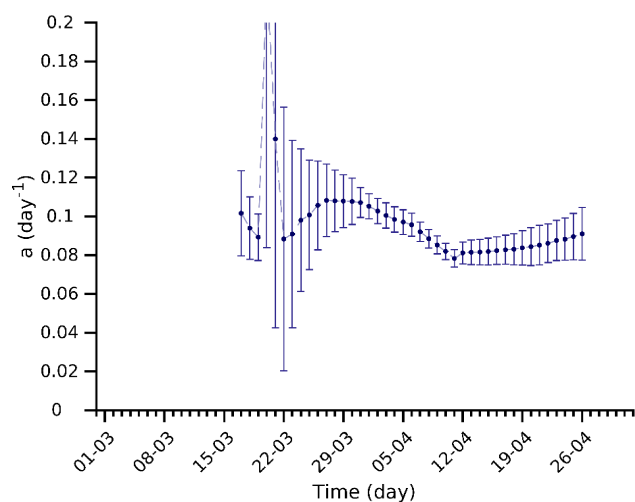
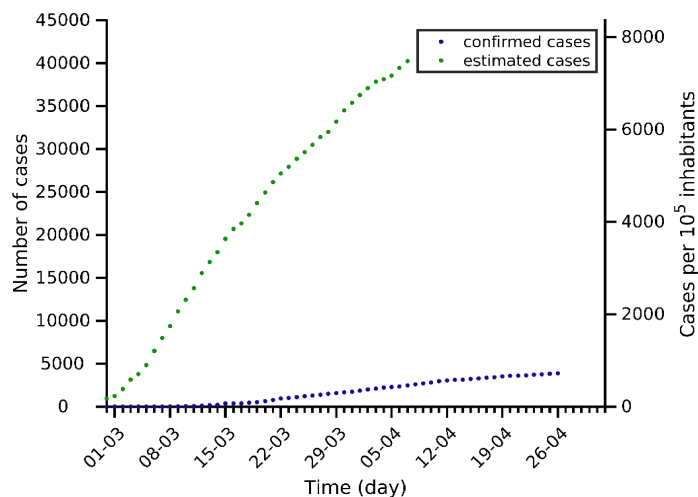
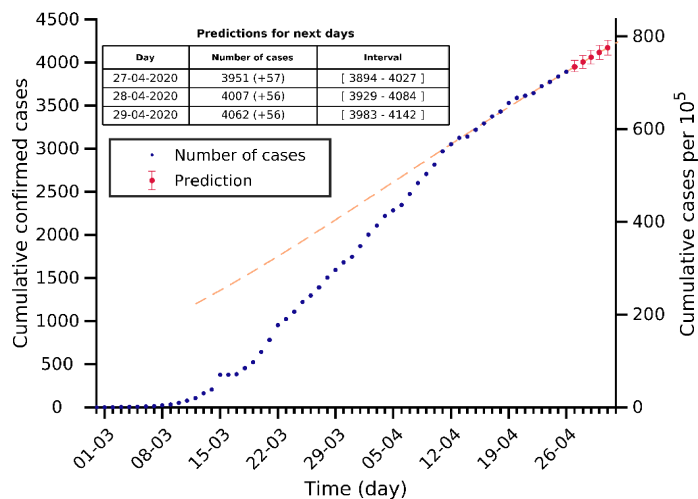
# Campania 26-04-2020. Population: 5.8M. Current cumulated incidence: 75/10<sup>5</sup>



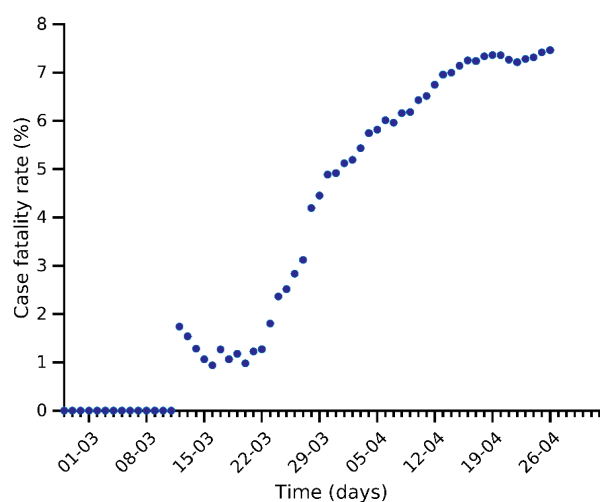
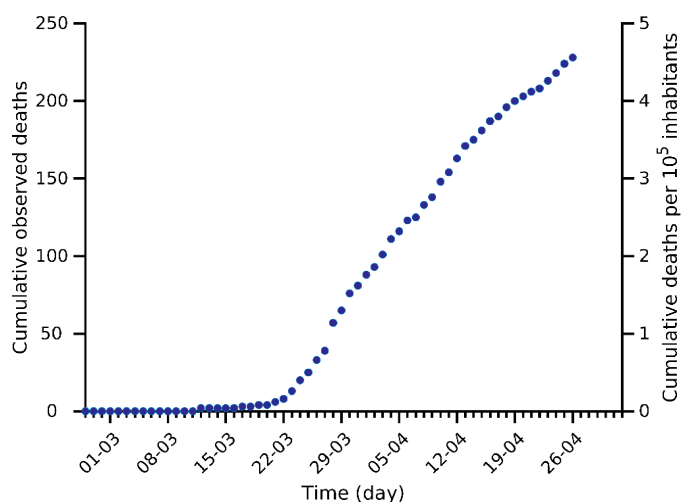
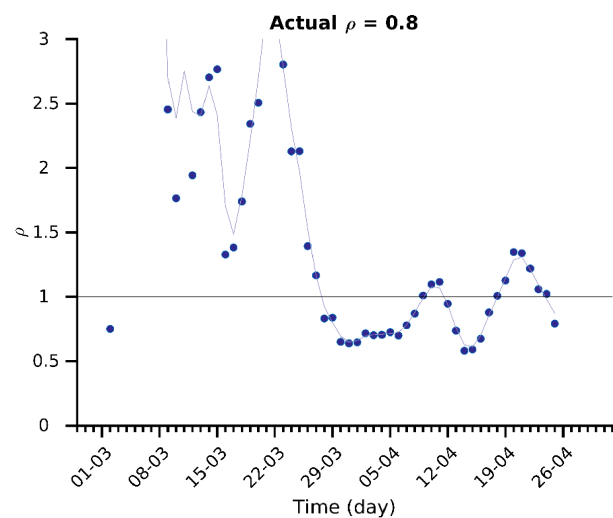
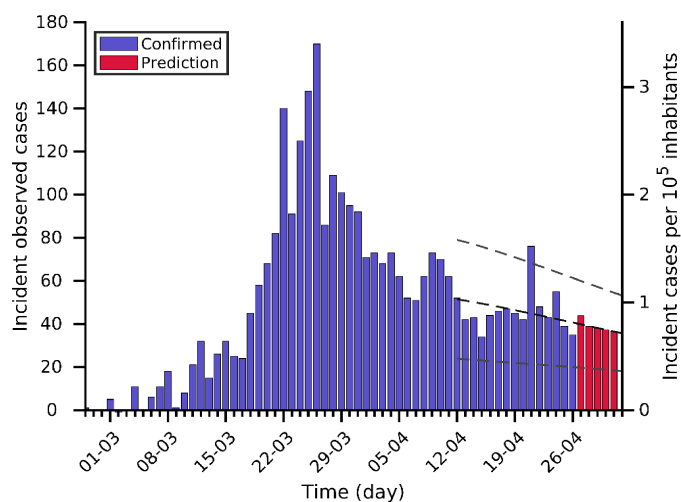
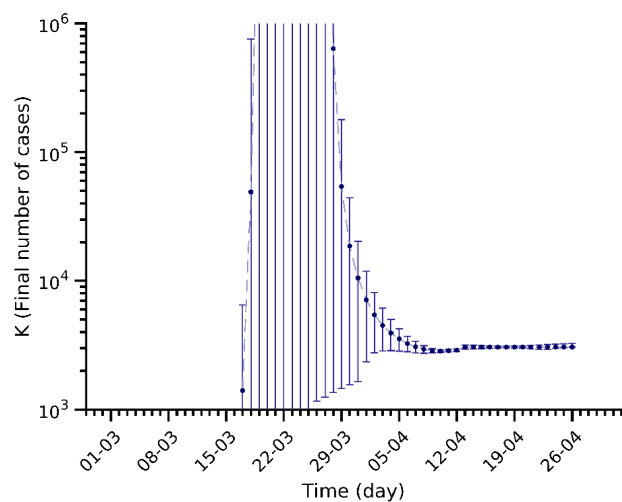
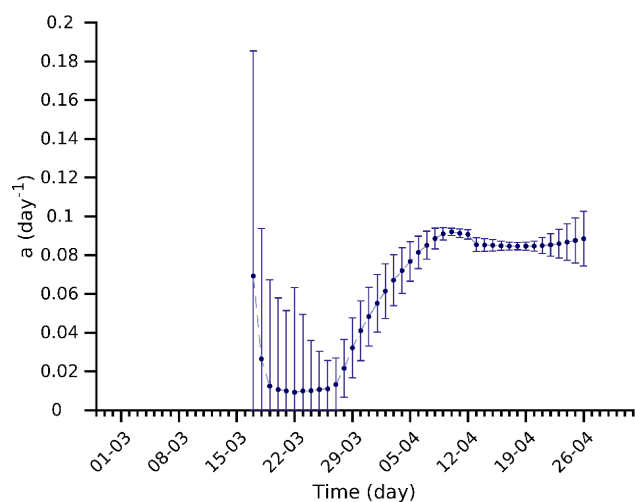
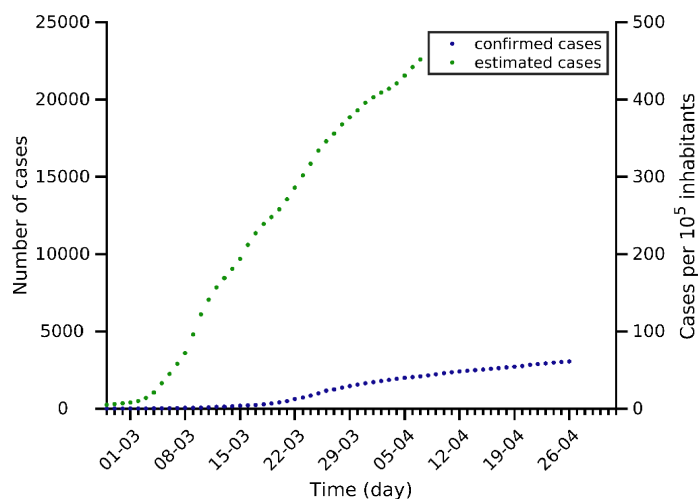
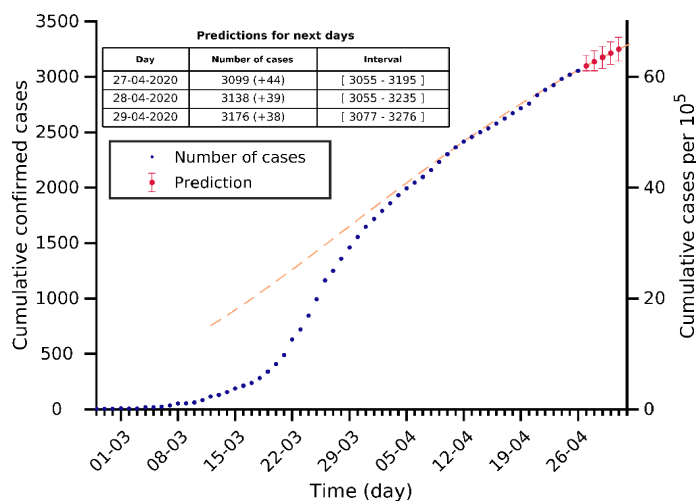
# Puglia 26-04-2020. Population: 4.0M. Current cumulated incidence: 98/10<sup>5</sup>



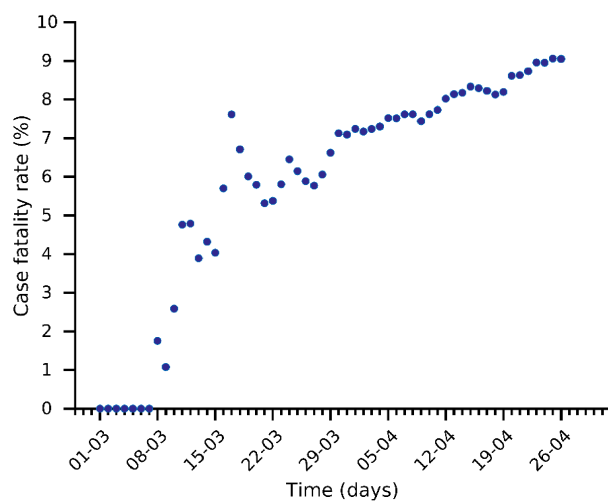
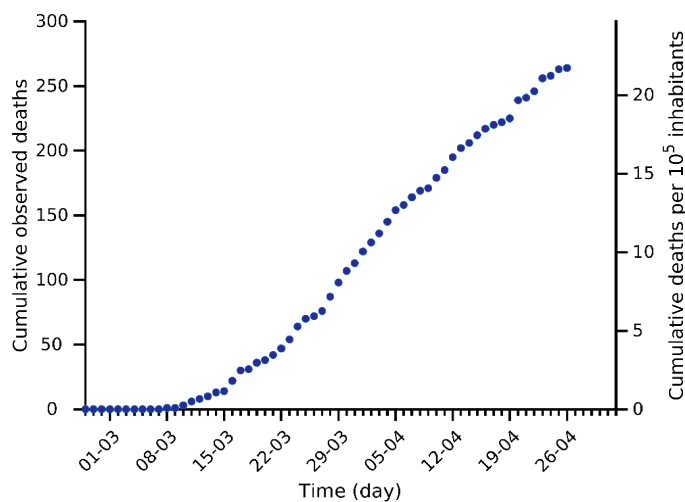
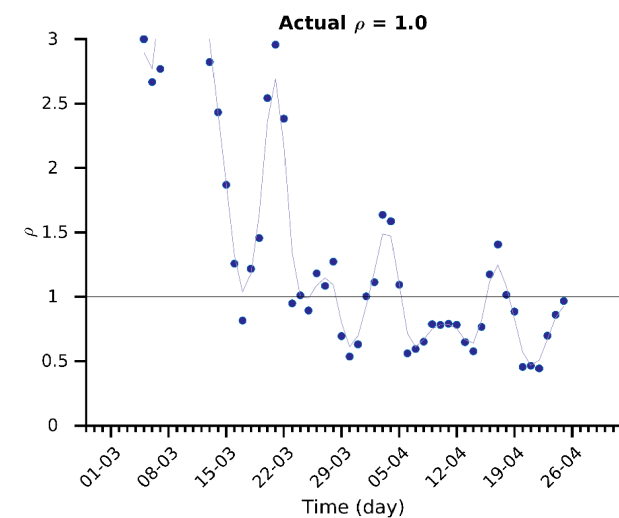
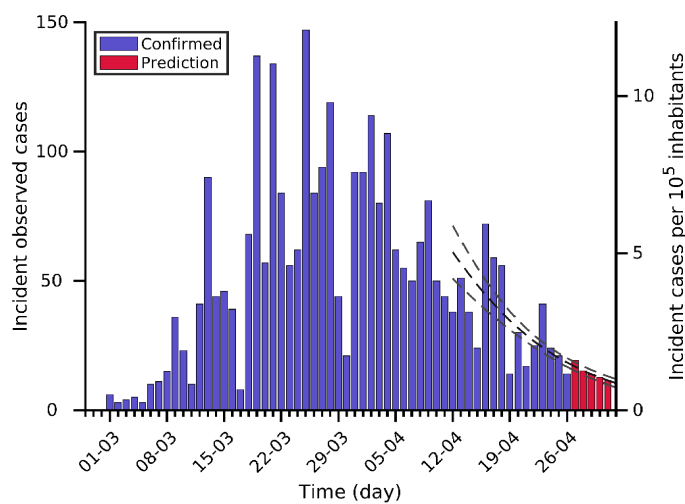
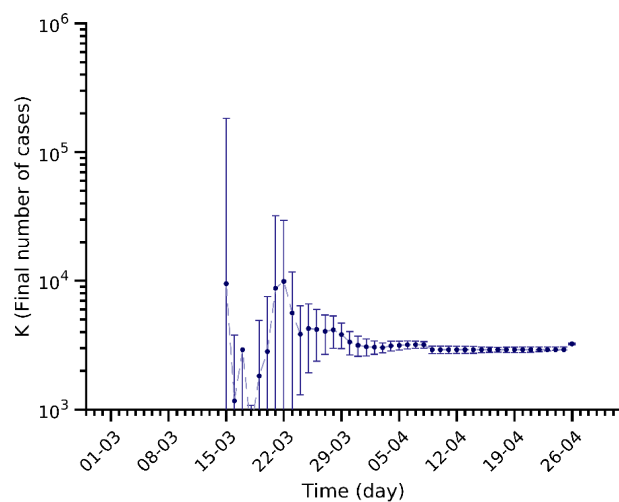
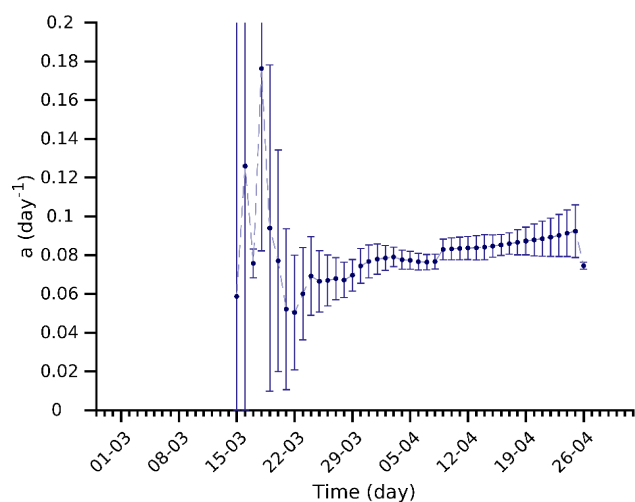
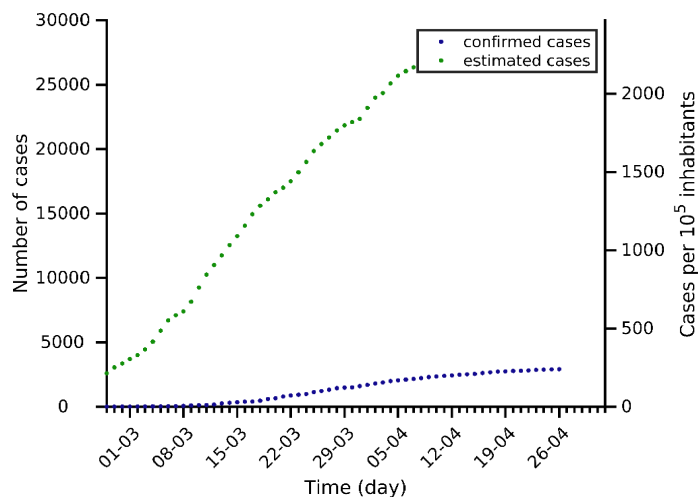
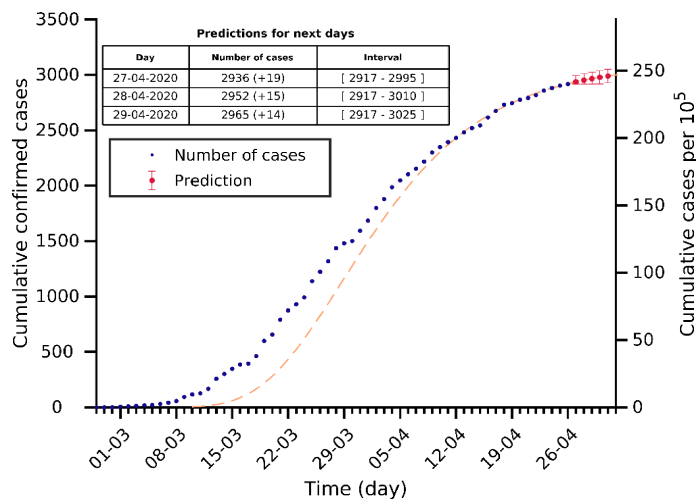
# Trento 26-04-2020. Population: 0.5M. Current cumulated incidence: 724/10<sup>5</sup>



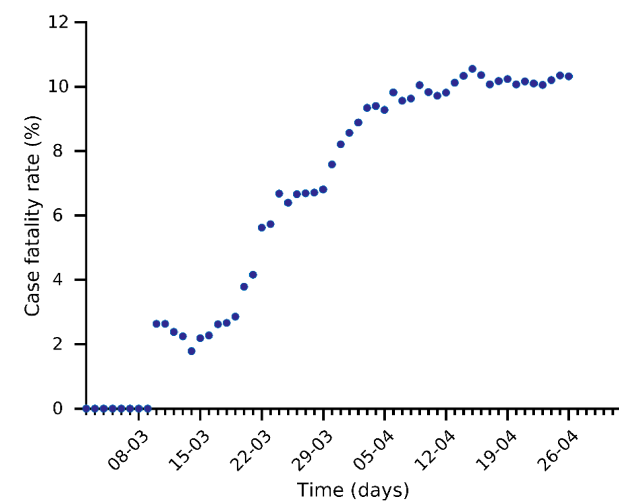
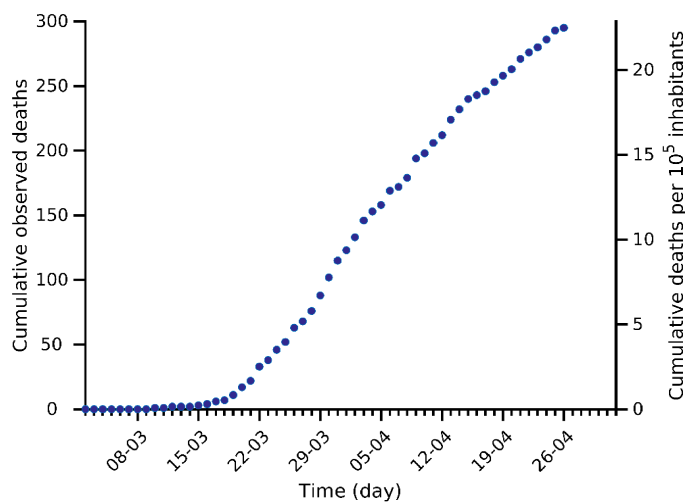
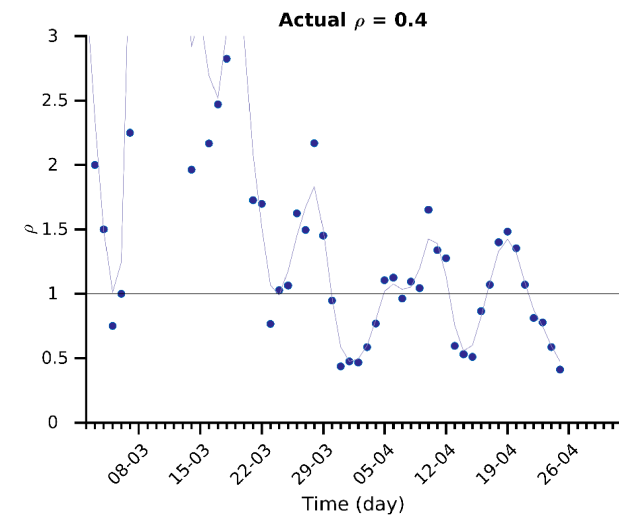
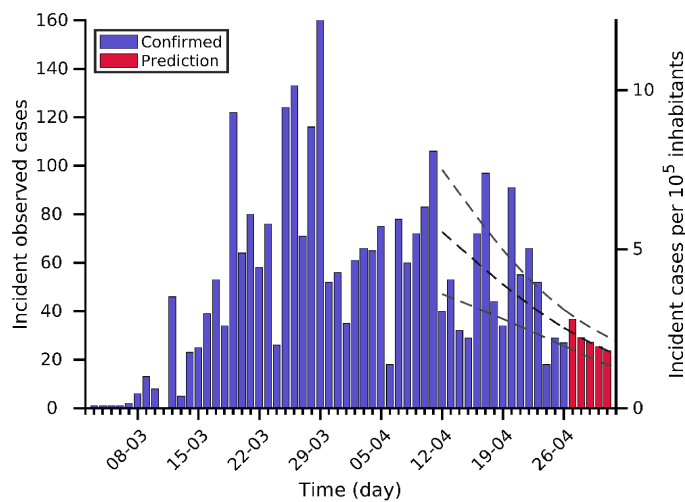
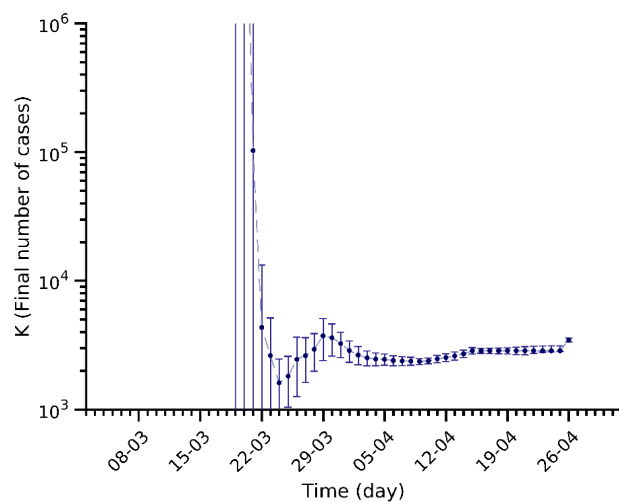
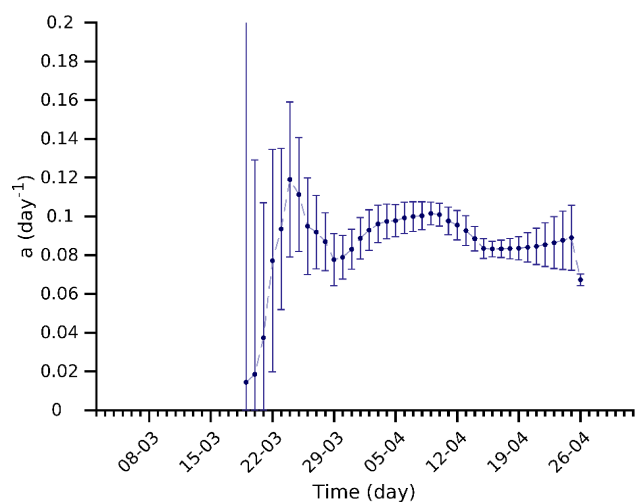
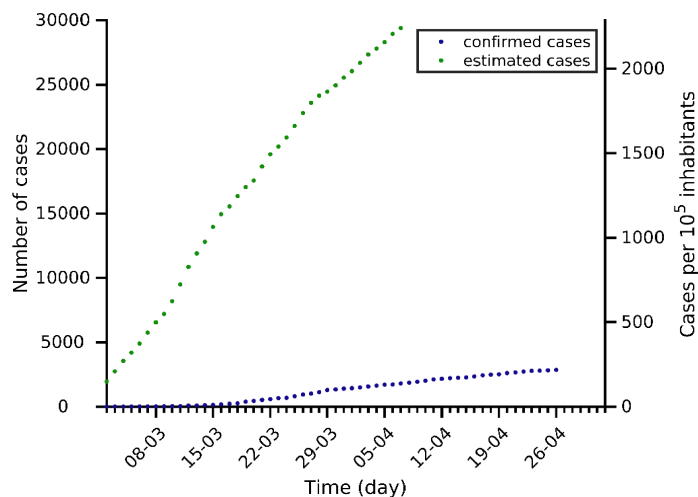
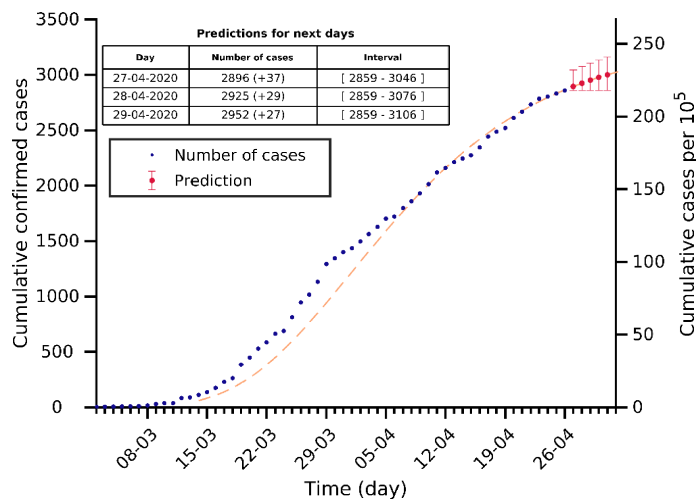
# Sicilia 26-04-2020. Population: 5.0M. Current cumulated incidence: 61/10<sup>5</sup>

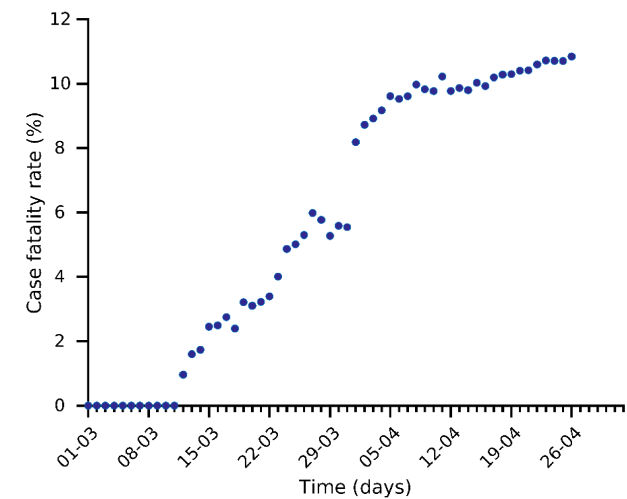
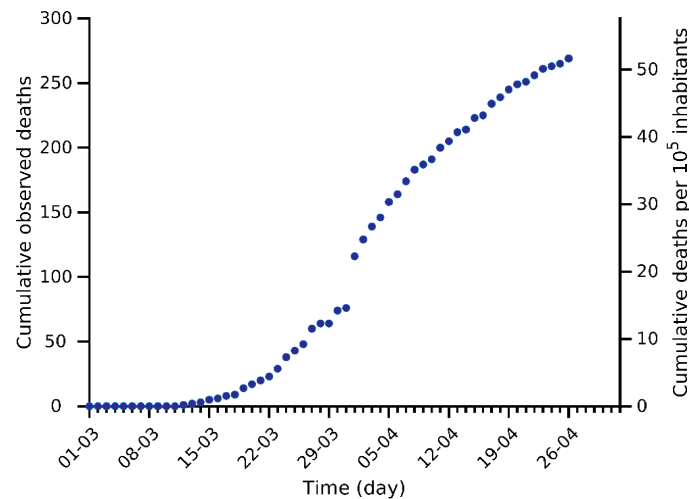
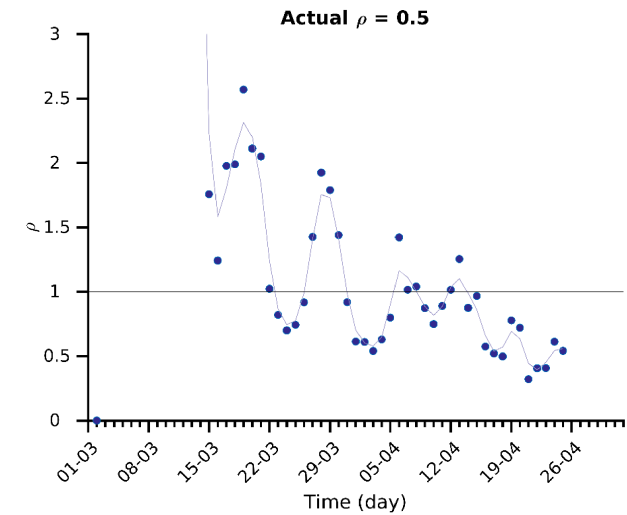
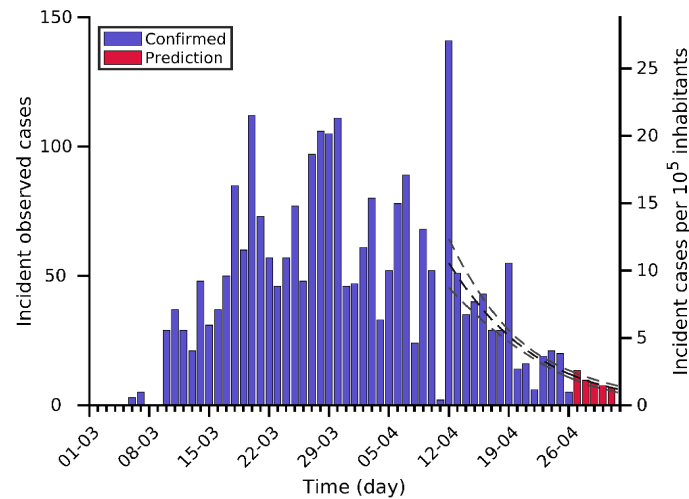
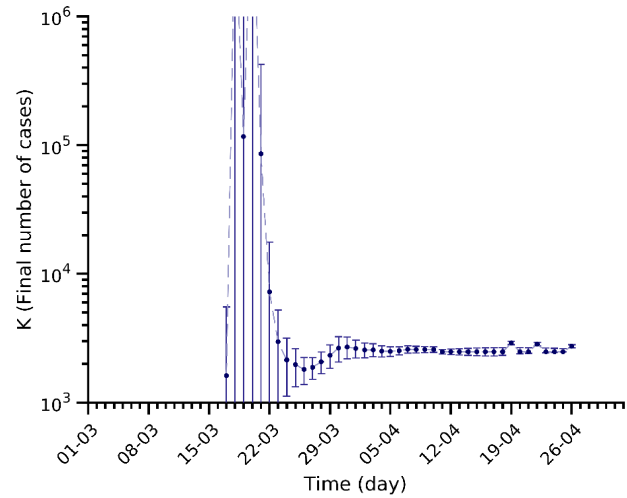
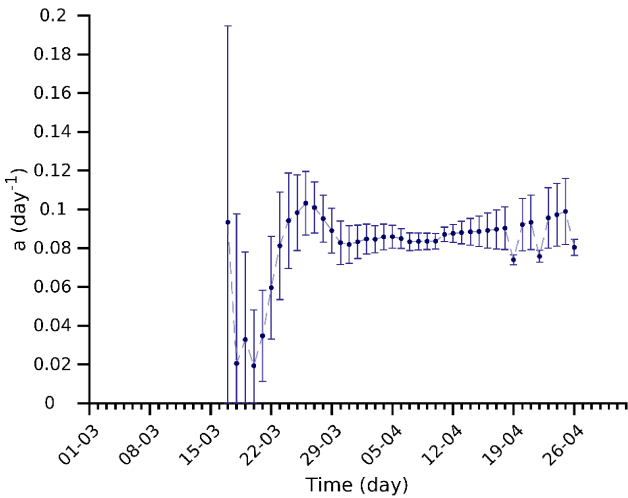
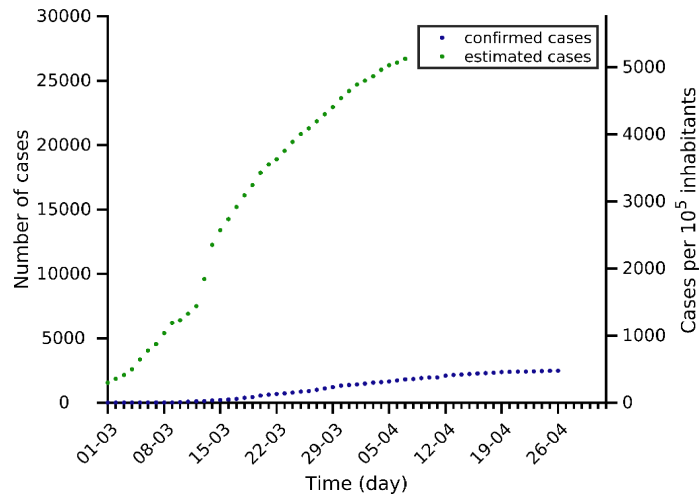
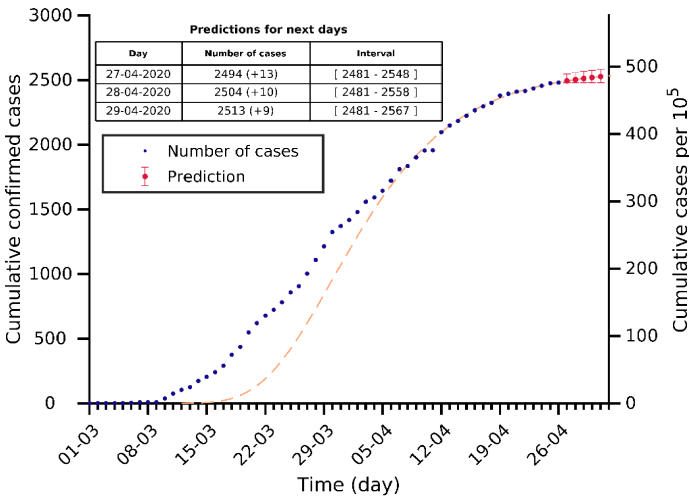


# Friuli Venezia Giulia 26-04-2020. Population: 1.2M. Current cumulated incidence: 2



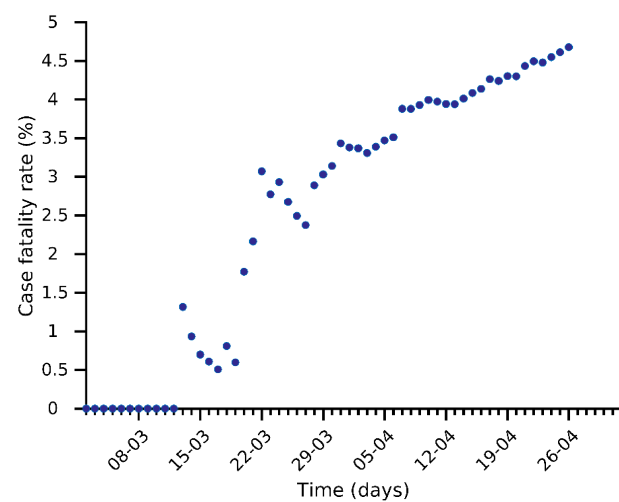
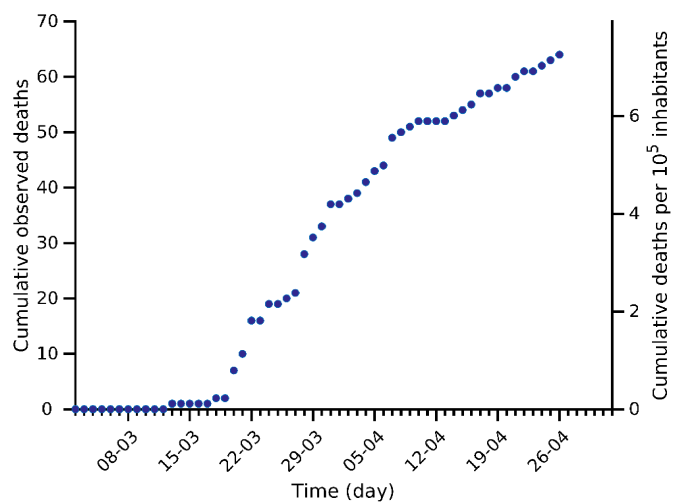
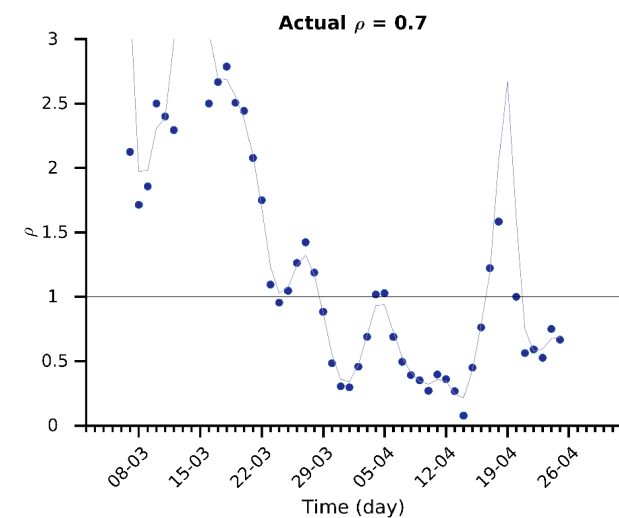
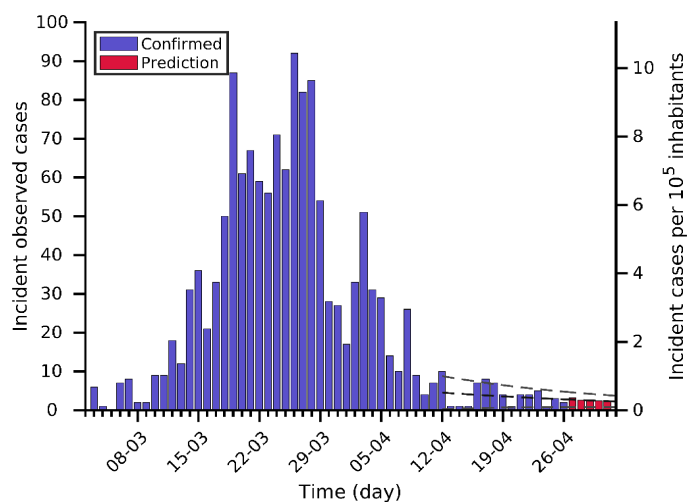
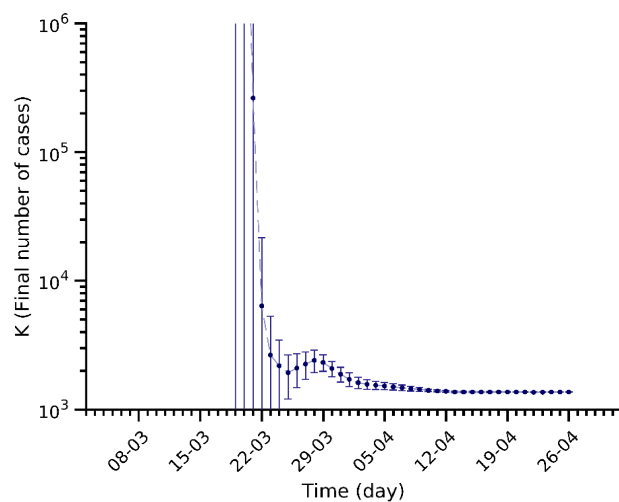
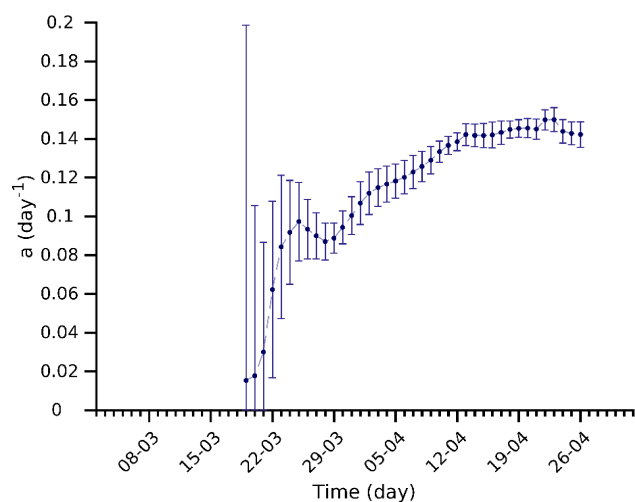
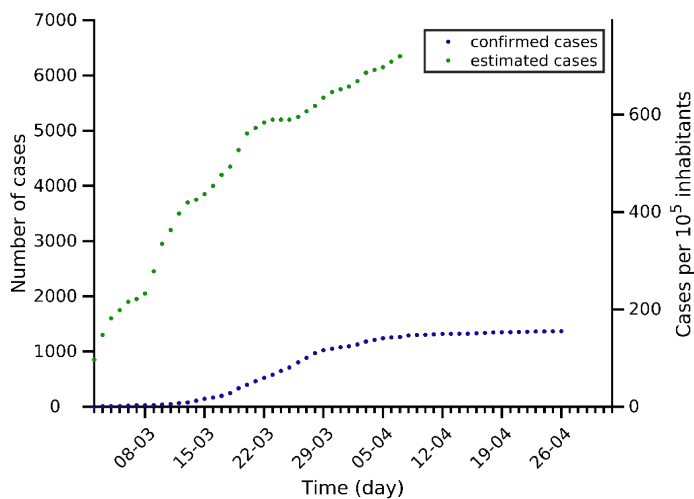
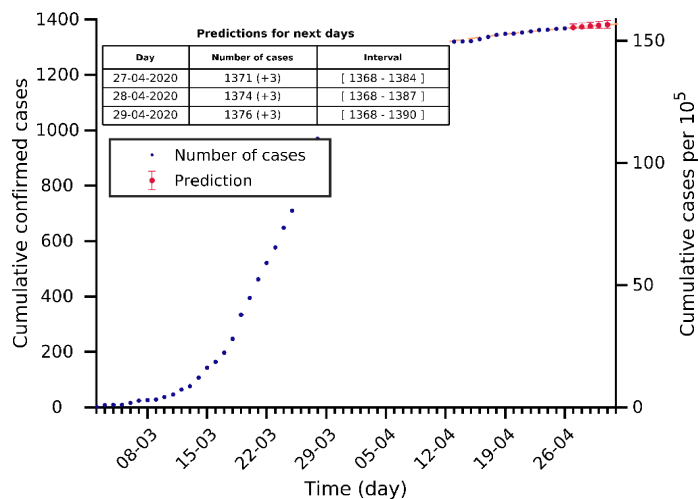
# Abruzzo 26-04-2020. Population: 1.3M. Current cumulated incidence: 218/10<sup>5</sup>



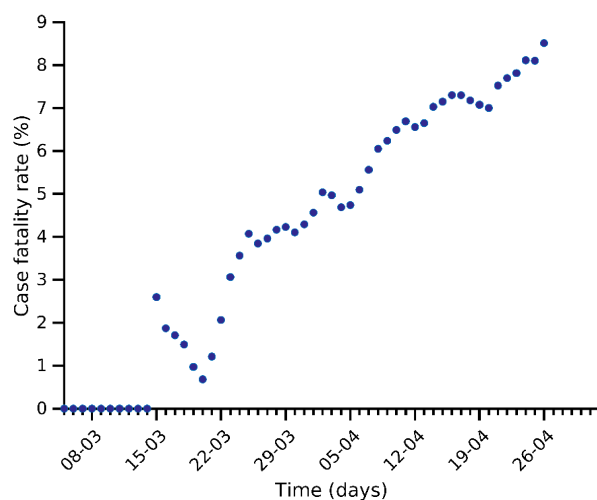
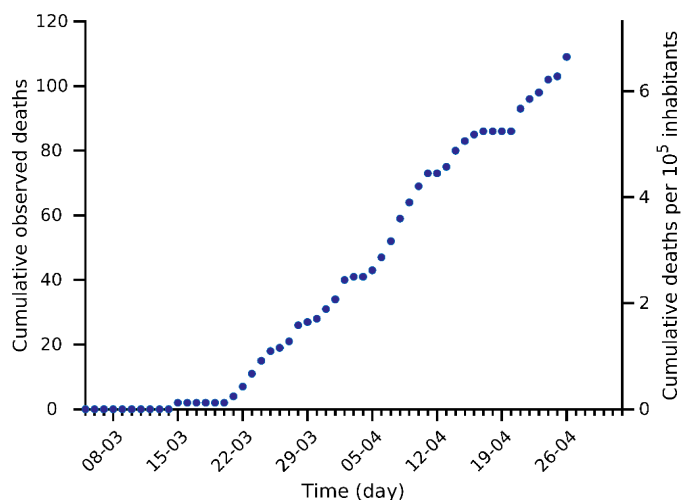
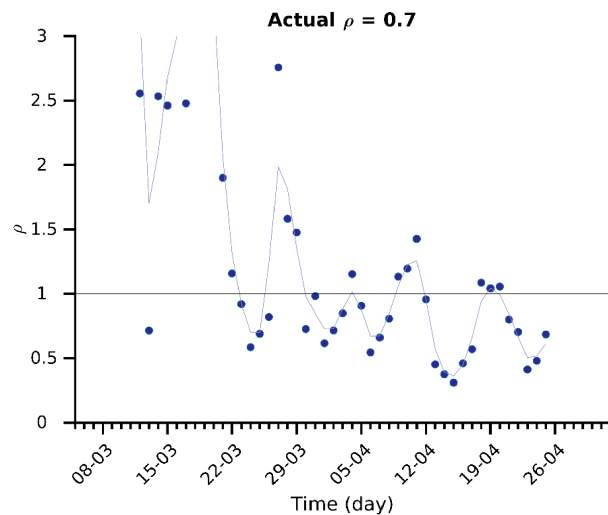
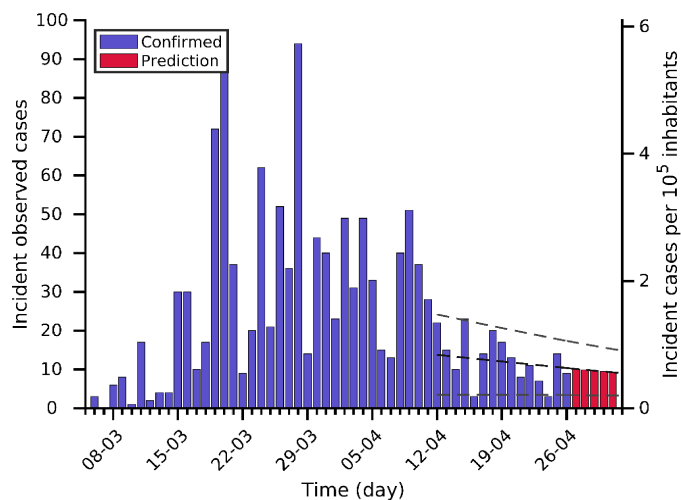
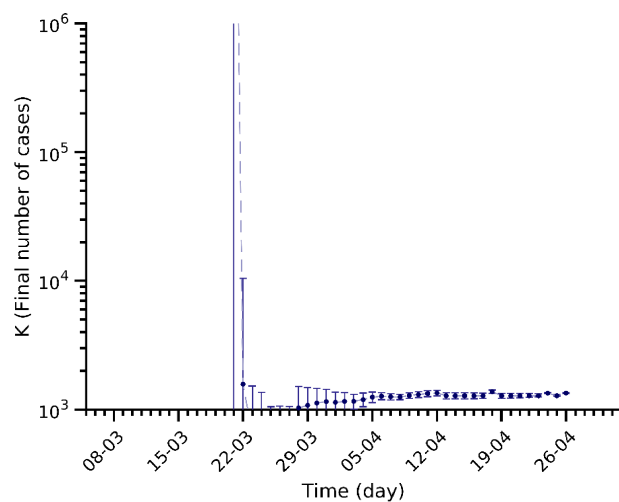
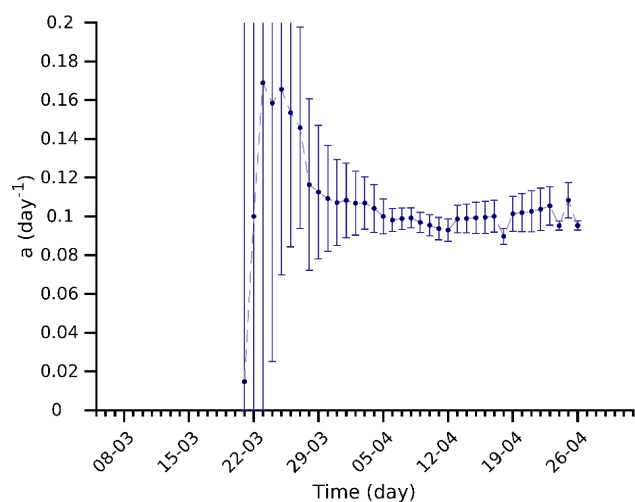
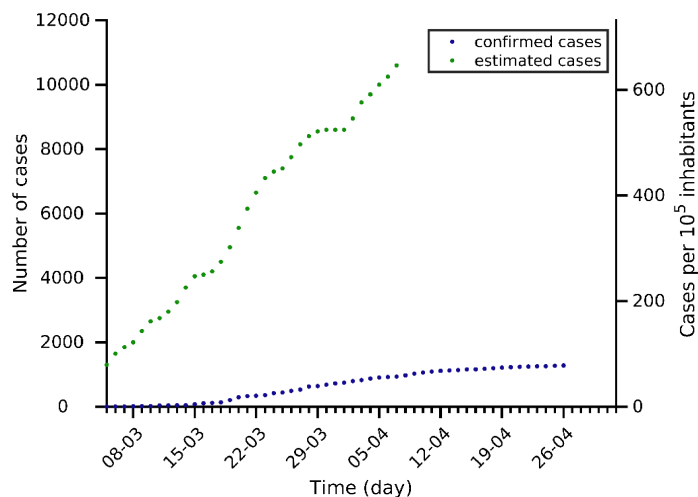
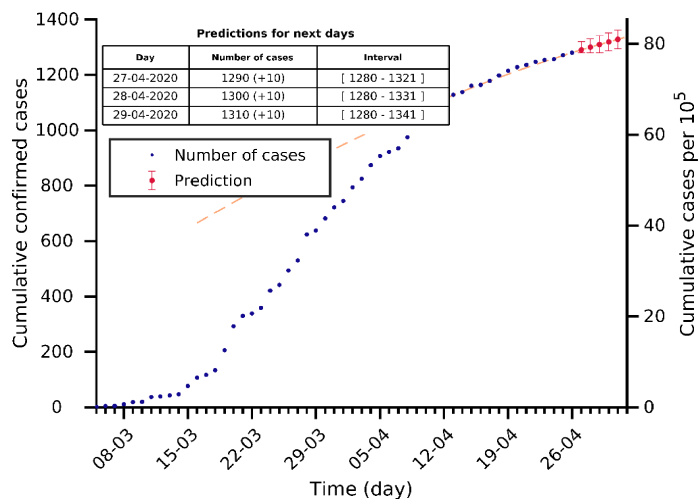




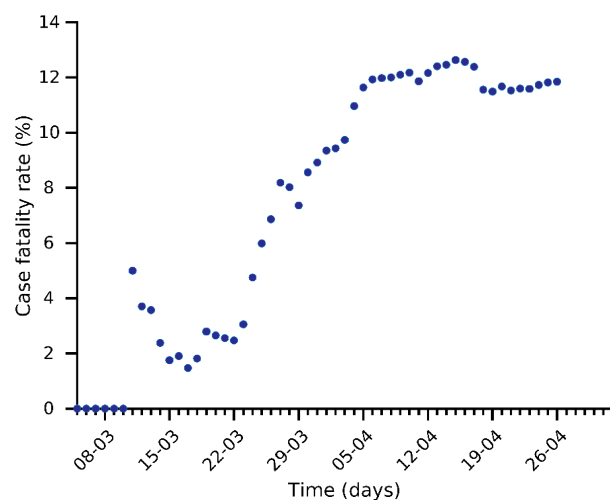
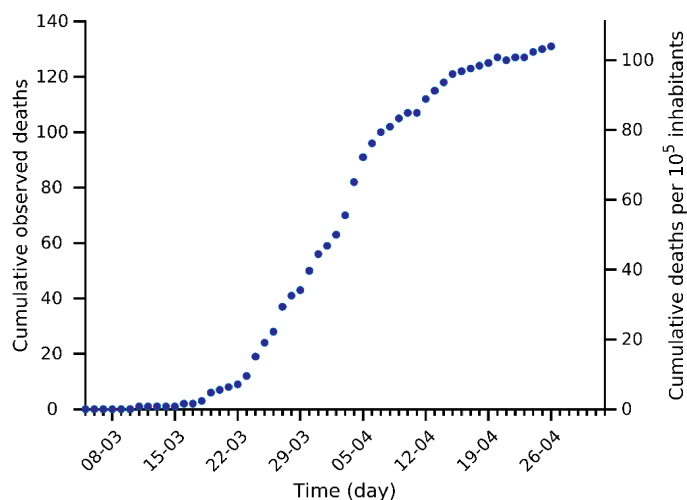
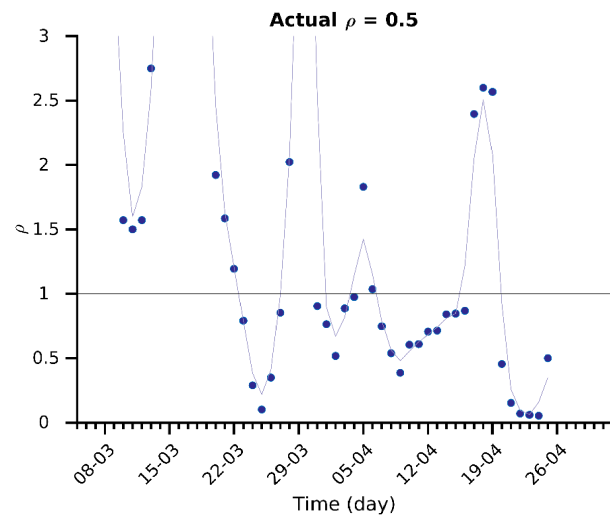
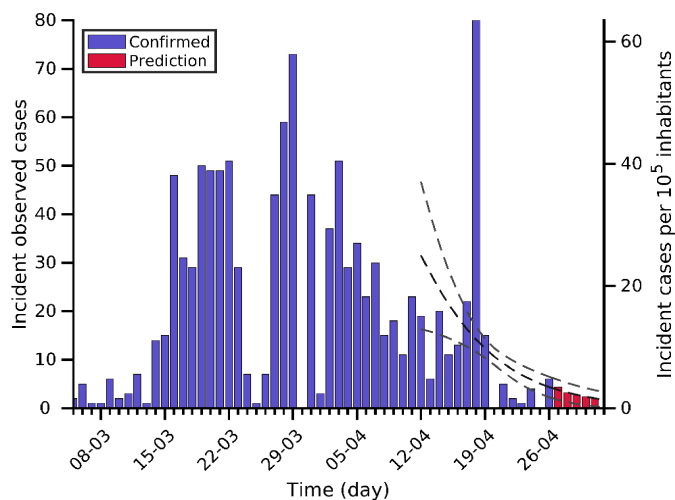
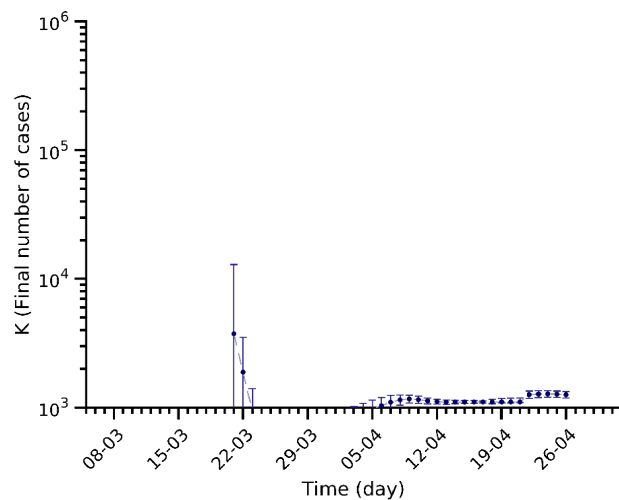
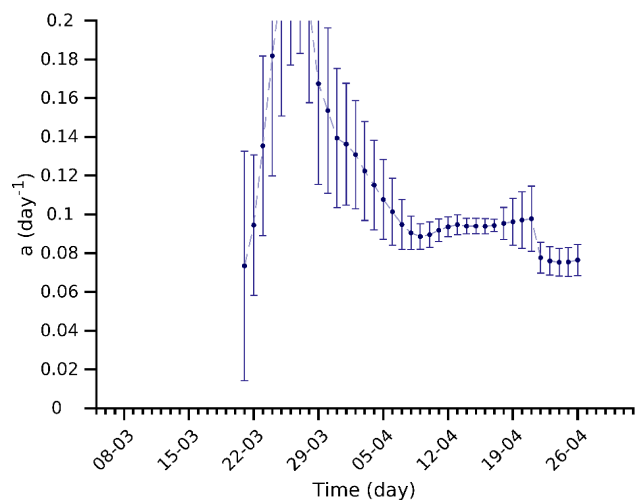
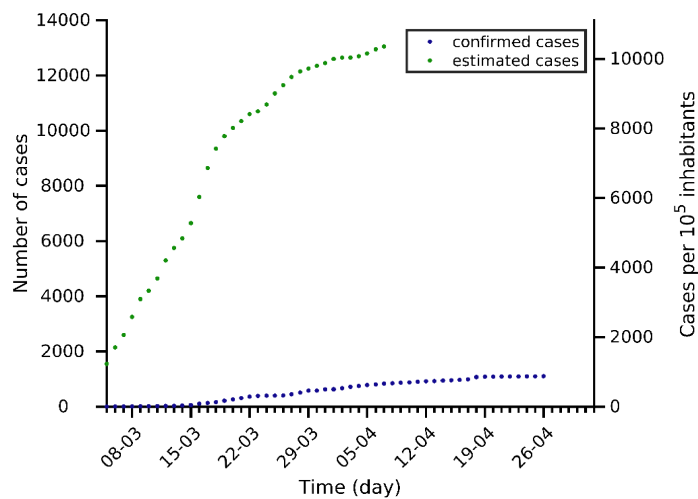
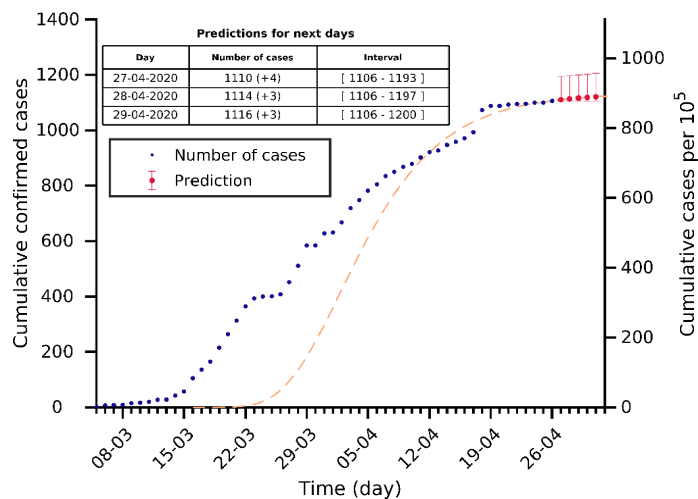
# Umbria 26-04-2020. Population: 0.9M. Current cumulated incidence: 155/10<sup>5</sup>



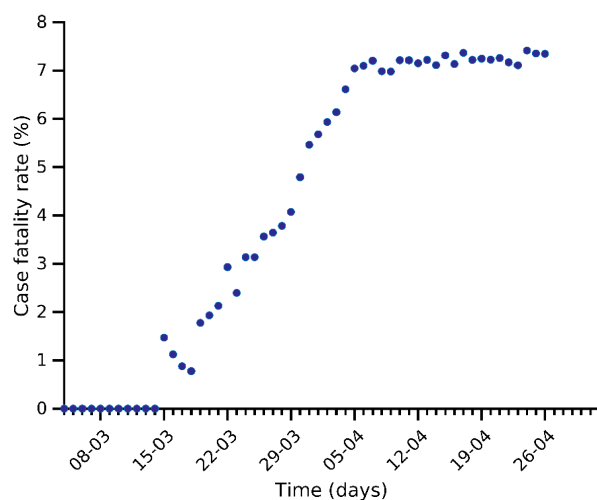
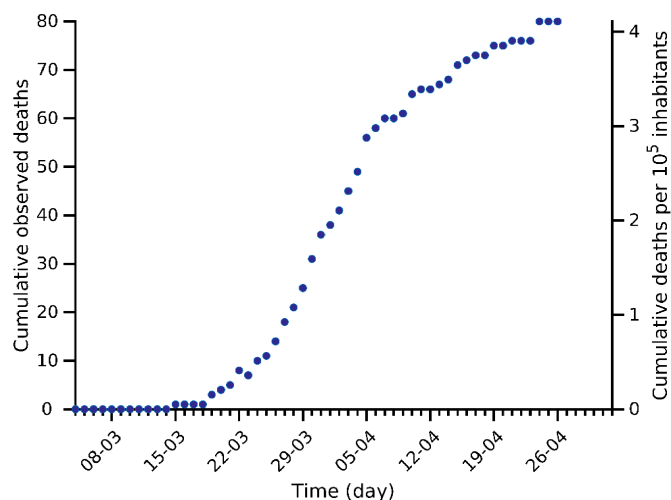
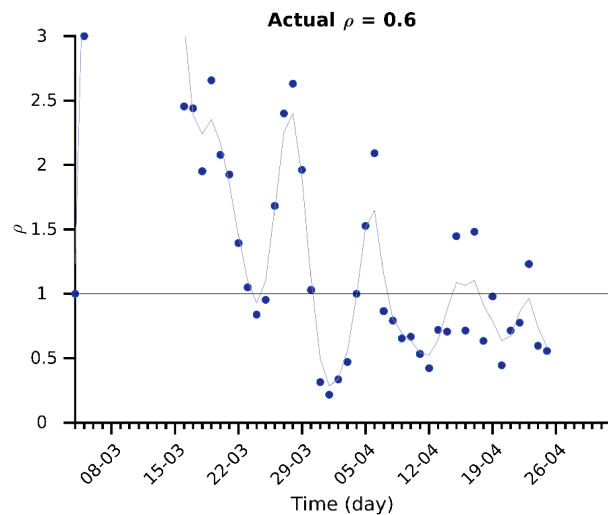
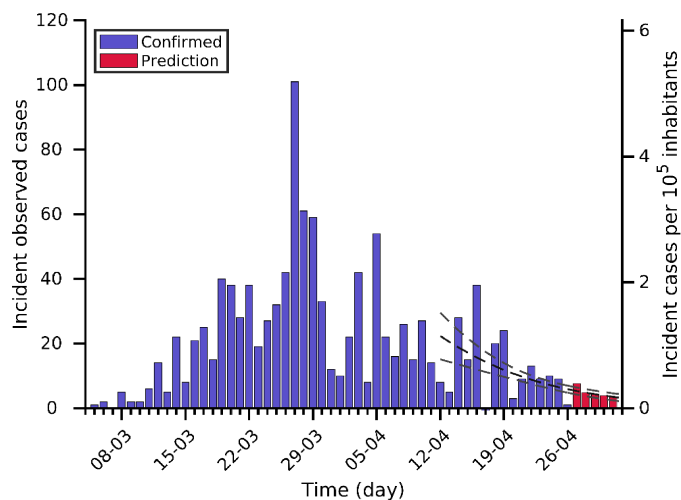
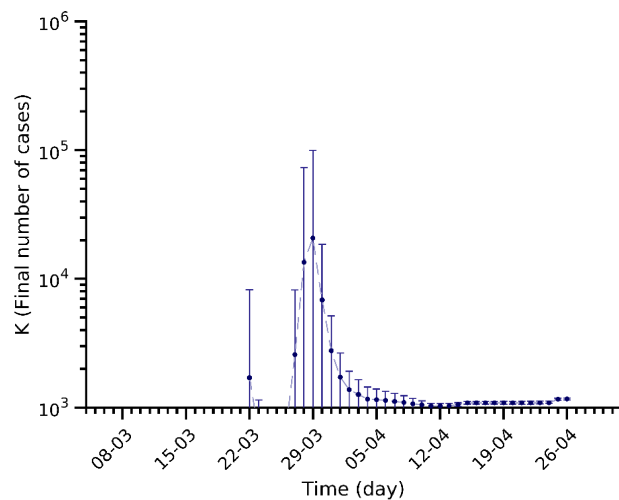
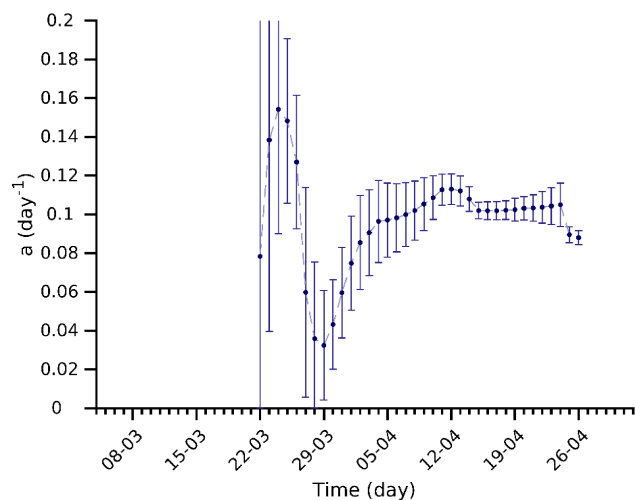
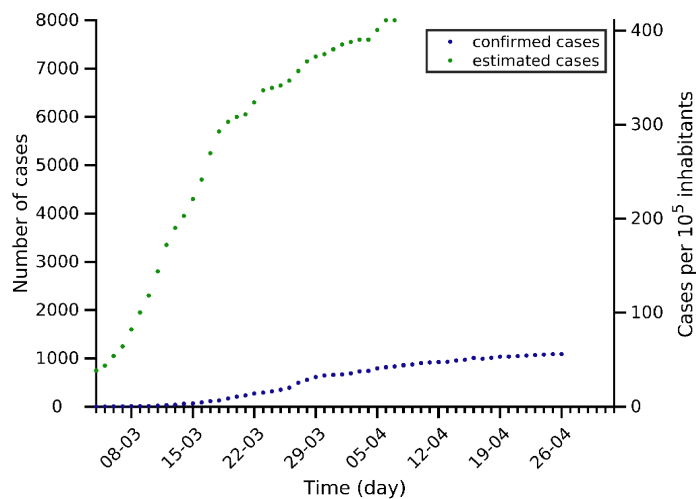
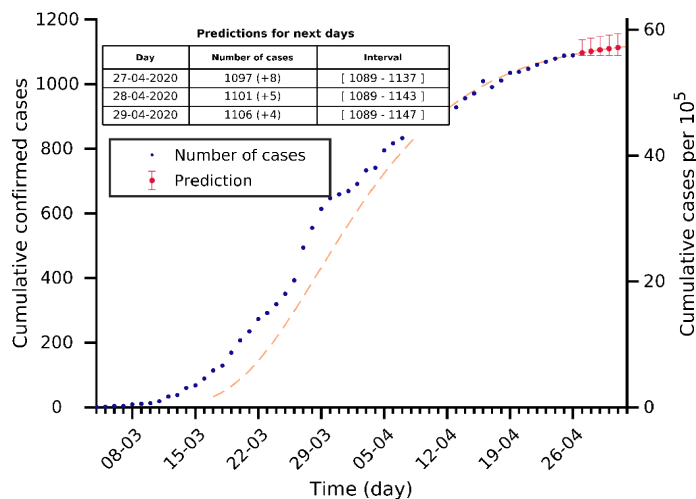
# Sardegna 26-04-2020. Population: 1.6M. Current cumulated incidence: 78/10<sup>5</sup>



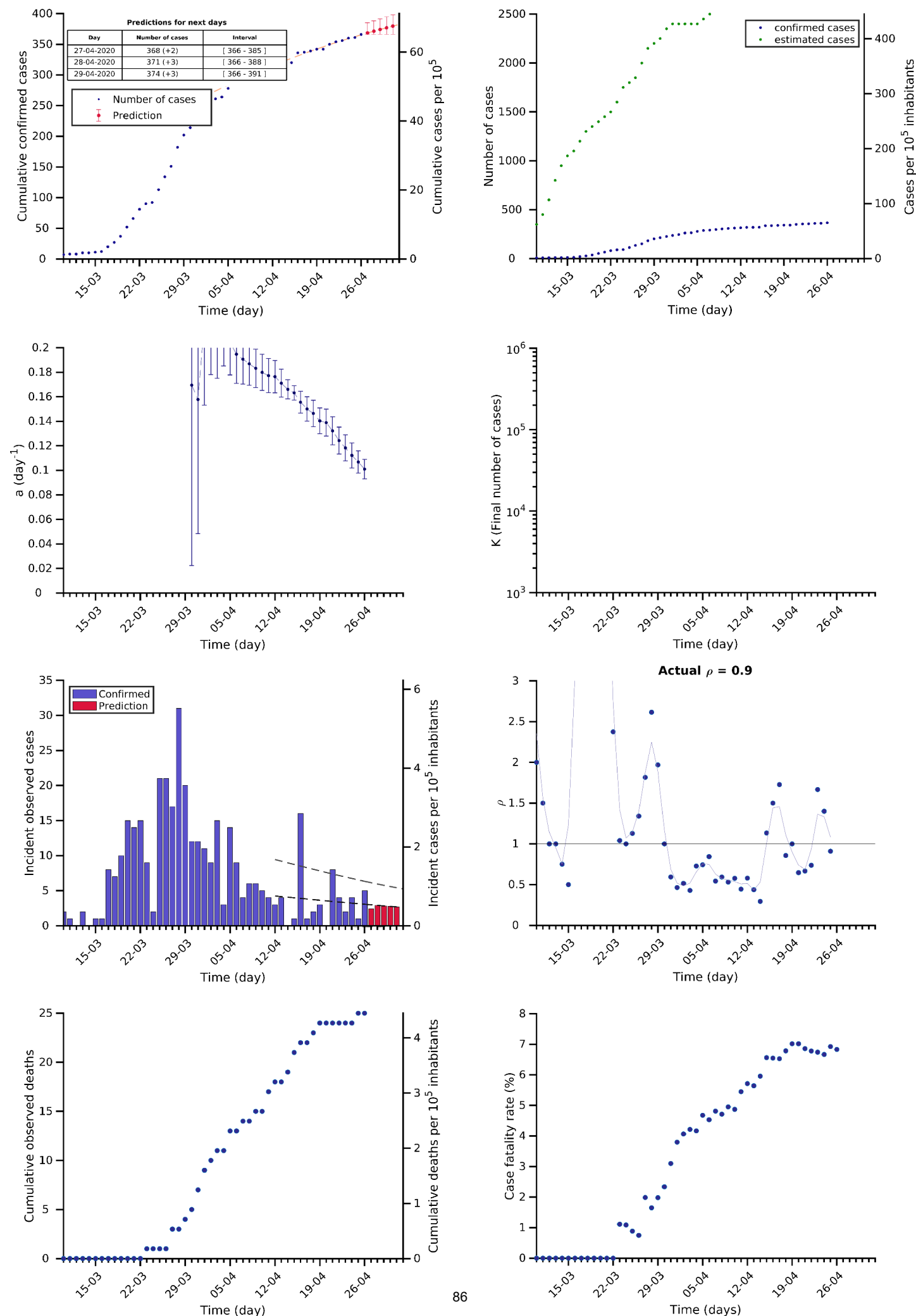
# Valle d'Aosta 26-04-2020. Population: 0.1M. Current cumulated incidence: 878/10<sup>5</sup>



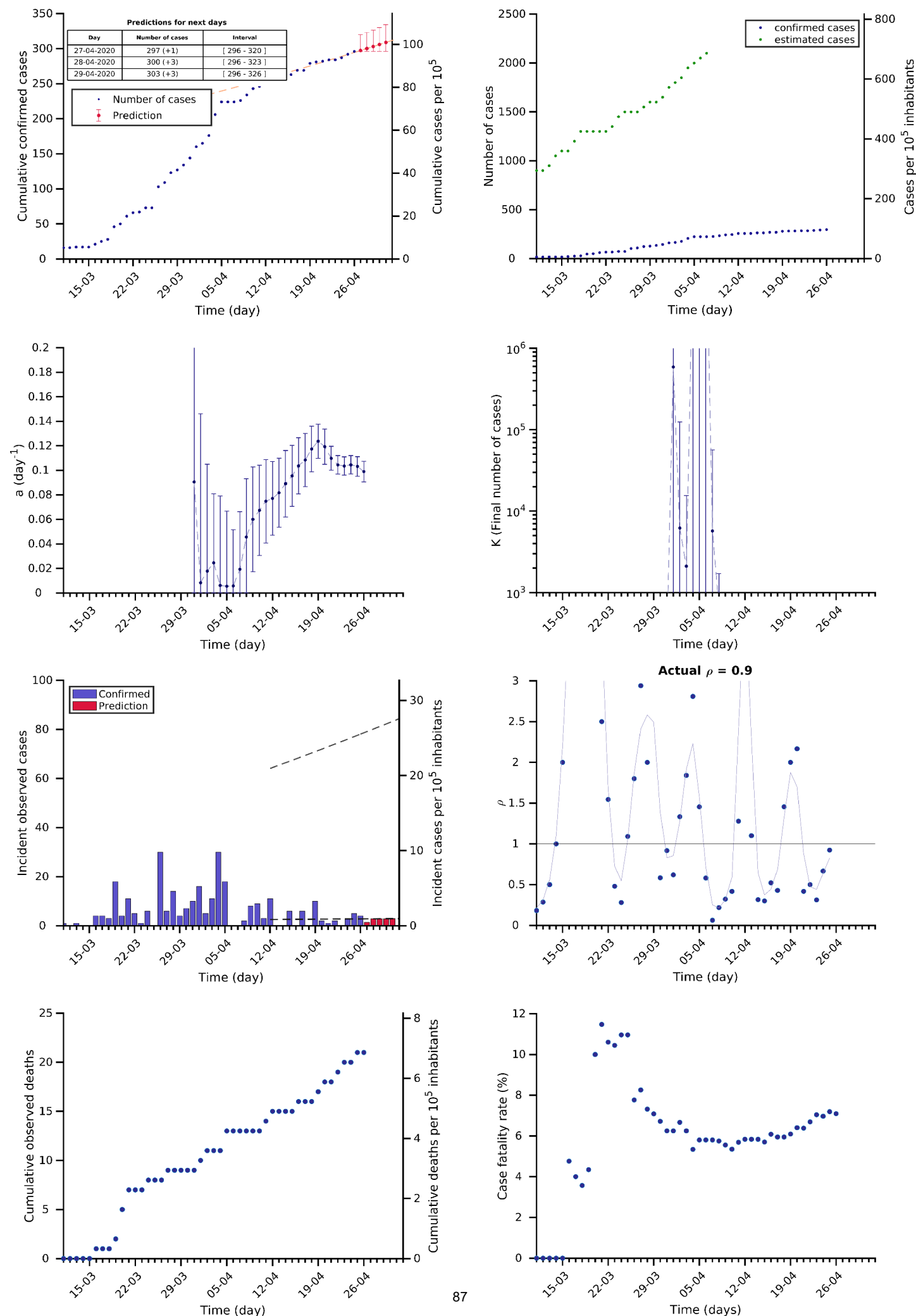
# Calabria 26-04-2020. Population: 1.9M. Current cumulated incidence: 56/10<sup>5</sup>



# Basilicata 26-04-2020. Population: 0.6M. Current cumulated incidence: 65/10<sup>5</sup>



# Molise 26-04-2020. Population: 0.3M. Current cumulated incidence: 97/10<sup>5</sup>



## Methods

## Methods

### **(1) Data source**

Data are daily obtained from World Health Organization (WHO) surveillance reports<sup>1</sup>, from European Centre for Disease Prevention and Control (ECDC)<sup>2</sup> and from Ministerio de Sanidad<sup>3</sup>. These reports are converted into text files that can be processed for subsequent analysis. Daily data comprise, among others: total confirmed cases, total confirmed new cases, total deaths, total new deaths. It must be considered that the report is always providing data from previous day. In the document we use the date at which the datapoint is assumed to belong, i.e., report from 15/03/2020 is giving data from 14/03/2020, the latter being used in the subsequent analysis.

### **(2) Data processing and plotting**

Data are initially processed with Matlab in order to update timeseries, i.e., last datapoints are added to historical sequences. These timeseries are plotted for EU individual countries and for the UE as a whole:

- ✓ Number of cumulated confirmed cases, in blue dots
- ✓ Number of reported new cases
- ✓ Number of cumulated deaths

Then, two indicators are calculated and plotted, too:

- ✓ Number of cumulated deaths divided by the number of cumulated confirmed cases, and reported as a percentage; it is an indirect indicator of the diagnostic level.
- ✓  $\rho$ : this variable is related with the reproduction number, i.e., with the number of new infections caused by a single case. It is evaluated as follows for the day before last report ( $t-1$ ):

$$\rho(t-1) = \frac{N_{new}(t) + N_{new}(t-1) + N_{new}(t-2)}{N_{new}(t-5) + N_{new}(t-6) + N_{new}(t-7)}$$

where  $N_{new}(t)$  is the number of new confirmed cases at day  $t$ .

### **(3) Classification of countries according to their status in the epidemic cycle**

The evolution of confirmed cases shows a biphasic behaviour:

- (I) an initial period where most of the cases are imported;
- (II) a subsequent period where most of new cases occur because of local transmission.

Once in the stage II, mathematical models can be used to track evolutions and predict tendencies. Focusing on countries that are on stage II, we classify them in three groups:

- Group A: countries that have reported more than 100 cumulated cases for 10 consecutive days or more;
- Group B: countries that have reported more than 100 cumulated cases for 7 to 9 consecutive days;
- Group C: countries that have reported more than 100 cumulated cases for 4 to 6 days.

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<sup>1</sup> <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/situation-reports>

<sup>2</sup> <https://www.ecdc.europa.eu/en/geographical-distribution-2019-ncov-cases>

<sup>3</sup> <https://www.mscbs.gob.es/profesionales/saludPublica/ccayes/alertasActual/nCov-China/situacionActual.htm>  
<https://github.com/datadista/datasets/tree/master/COVID%2019>



#### **(4) Fitting a mathematical model to data**

Previous studies have shown that Gompertz model<sup>4</sup> correctly describes the Covid-19 epidemic in all analysed countries. It is an empirical model that starts with an exponential growth but that gradually decreases its specific growth rate. Therefore, it is adequate for describing an epidemic that is characterized by an initial exponential growth but a progressive decrease in spreading velocity provided that appropriate control measures are applied.

Gompertz model is described by the equation:

$$N(t) = K e^{-\ln\left(\frac{K}{N_0}\right) \cdot e^{-a \cdot (t-t_0)}}$$

where  $N(t)$  is the cumulated number of confirmed cases at  $t$  (in days), and  $N_0$  is the number of cumulated cases the day at day  $t_0$ . The model has two parameters:

- ✓  $a$  is the velocity at which specific spreading rate is slowing down;
- ✓  $K$  is the expected final number of cumulated cases at the end of the epidemic.

This model is fitted to reported cumulated cases of the UE and of countries in stage II that accomplish two criteria: 4 or more consecutive days with more than 100 cumulated cases, and at least one datapoint over 200 cases. Day  $t_0$  is chosen as that one at which  $N(t)$  overpasses 100 cases. If more than 15 datapoints that accomplish the stated criteria are available, only the last 15 points are used. The fitting is done using Matlab's Curve Fitting package with Nonlinear Least Squares method, which also provides confidence intervals of fitted parameters ( $a$  and  $K$ ) and the  $R^2$  of the fitting. At the initial stages the dynamics is exponential and  $K$  cannot be correctly evaluated. In fact, at this stage the most relevant parameter is  $a$ . Fitted curves are incorporated to plots of cumulative reported cases with a dashed line. Once a new fitting is done, two plots are added to the country report:

- ✓ Evolution of fitted  $a$  with its error bars, i.e., values obtained on the fitting each day that the analysis has been carried out;
- ✓ Evolution of fitted  $K$  with its error bars, i.e., values obtained on the fitting each day that the analysis has been carried out; if lower error bar indicates a value that is lower than current number of cases, the error bar is truncated.

These plots illustrate the increase in fittings' confidence, as fitted values progressively stabilize around a certain value and error bars get smaller when the number of datapoints increases. In fact, in the case of countries, they are discarded and set as "Not enough data" if  $a > 0.2 \text{ day}^{-1}$ , if  $K > 10^6$  or if the error in  $K$  overpasses  $10^6$ .

It is worth to mention that the simplicity of this model and the lack of previous assumptions about the Covid-19 behaviour make it appropriate for universal use, i.e., it can be fitted to any country independently of its socioeconomic context and control strategy. Then, the model is capable of quantifying the observed dynamics in an objective and standard manner and predicting short-term tendencies.

#### **(5) Using the model for predicting short-term tendencies**

The model is finally used for a short-term prediction of the evolution of the cumulated number of cases. The predictions increase their reliability with the number of datapoints used in the fitting. Therefore, we consider three levels of prediction, depending on the country:

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<sup>4</sup> Madden LV. Quantification of disease progression. Protection Ecology 1980; 2: 159-176.

- Group A: prediction of expected cumulated cases for the following 3-5 days<sup>5</sup>;
- Group B: prediction of expected cumulated cases for the following 2 days;
- Group C: prediction of expected cumulated cases for the following day.

The confidence interval of predictions is assessed with the Matlab function `predint`, with a 99% confidence level. These predictions are shown in the plots as red dots with corresponding error bars, and also gathered in the attached table. For series longer than 9 timepoints, last 3 points are weighted in the fitting so that changes in tendencies are well captured by the model.

### ***(6) Estimating non-diagnosed cases***

Lethality of Covid-19 has been estimated at around 1 % for Republic of Korea and the Diamond Princess cruise. Besides, median duration of viral shedding after Covid-19 onset has been estimated at 18.5 days for non-survivors<sup>6</sup> in a retrospective study in Wuhan. These data allow for an estimation of total number of cases, considering that the number of deaths at certain moment should be about 1 % of total cases 18.5 days before. This is valid for estimating cases of countries at stage II, since in stage I the deaths would be mostly due to the incidence at the country from which they were imported. We establish a threshold of 50 reported cases before starting this estimation.

Reported deaths are passed through a moving average filter of 5 points in order to smooth tendencies. Then, the corresponding number of cases is found assuming the 1 % lethality. Finally, these cases are distributed between 18 and 19 days before each one.

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<sup>5</sup> At this moment we are testing predictions at 4 days for countries with more than 100 cumulated cases for 13-15 consecutive days, and 5 days for 16 or more days.

<sup>6</sup> Zhou et al., 2020. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. The Lancet; March 9, doi: 10.1016/S0140-6736(20)30566-3